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VOLUME XXXVIII NO. 199 JULY-AUGUST 1953

COL. JOHN SLEZAK
Assistant Secretary
of the Army

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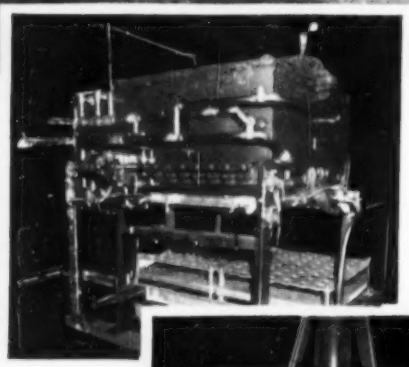
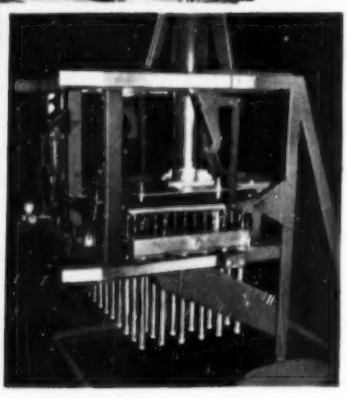


Volumetric Pouring Unit



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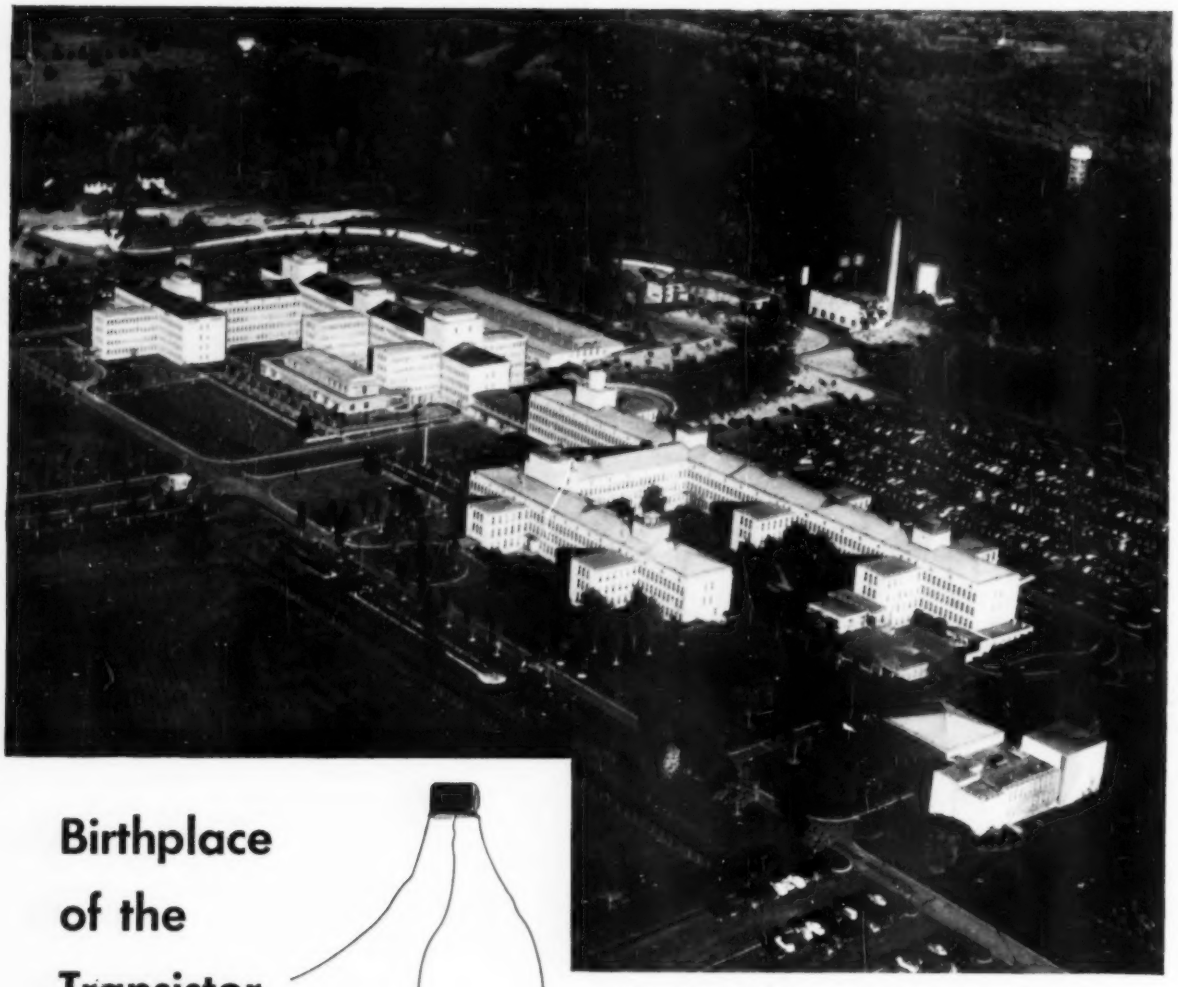

Birthplace of the Transistor

Bell Telephone Laboratories at Murray Hill, N. J. Other laboratories are in New York City and at Whippany and Holmdel, N. J.

The ***Transistor***, that revolutionary new electronics device, is a product of *telephone* research. It was conceived, invented and developed at Bell Telephone Laboratories by men in search of ways to improve telephone service. It was announced just five years ago.

The ***Transistor*** can do most of the things that vacuum tubes can do—and others, too—but it is not a vacuum tube. It works on entirely new physical principles. Rugged, simple and tiny, the Transistor uses incredibly small amounts of power—and then only when actually operating.

Transistors promise smaller and cheaper electronic equipment and the spread of electronics where other equipment has not been able to do the job as economically. They are already at work in the Bell System, generating the signals that carry dialed numbers between cities, and selecting the best route for calls through complex switching systems. Engineers see many other possibilities: for example, as voice amplifiers in telephone sets to aid the hard of hearing, and as switches.

Recognizing the tremendous possibilities of the ***Transistor*** in every phase of the electronics industry, the Bell System has made the invention available to 40 other companies. Thus, again, basic research to improve telephony contributes importantly to many other fields of technology as well.

TRANSISTOR SUMMARY

Basically, a ***Transistor*** is a tiny wafer of germanium with three electrodes, over-all about the size of a coffee bean.

It can amplify signals 100,000 times on much less power than a pocket flashlight requires. This opens the door to its use in smaller telephone exchanges where vacuum tube equipment would be too costly to operate.

Unlike a vacuum tube, the ***Transistor*** has no vacuum and no filament to keep hot. It operates instantly, without "warm-up" delay. The Transistor can also be used as an electric eye and to count electrical pulses.

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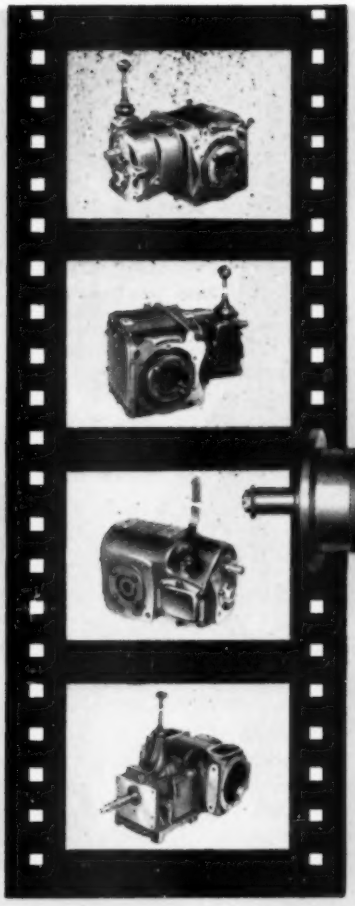

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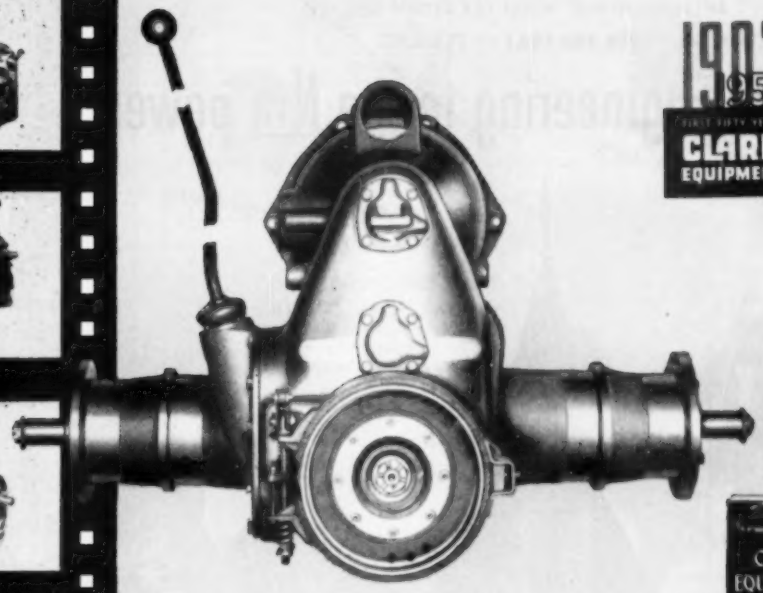

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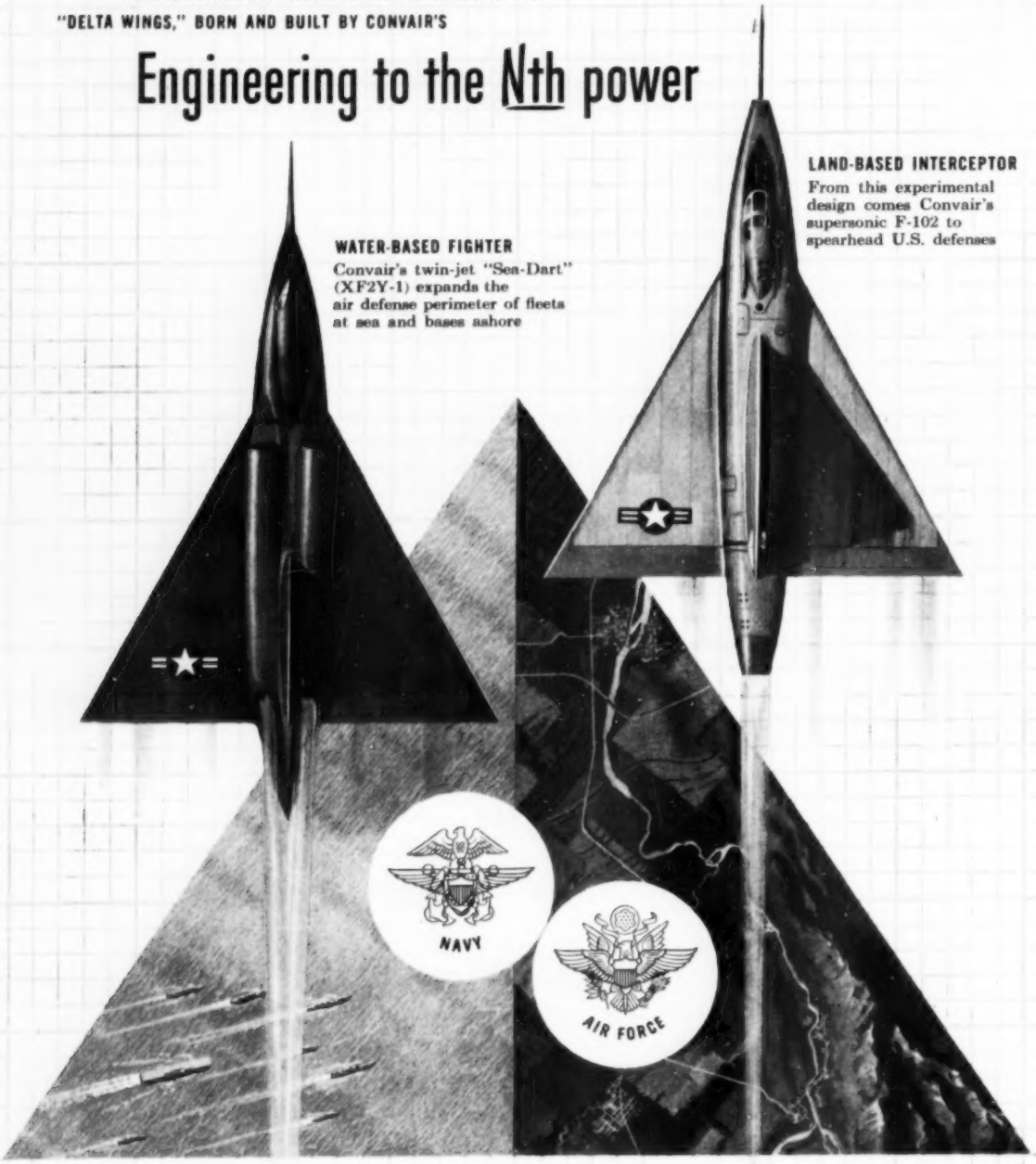

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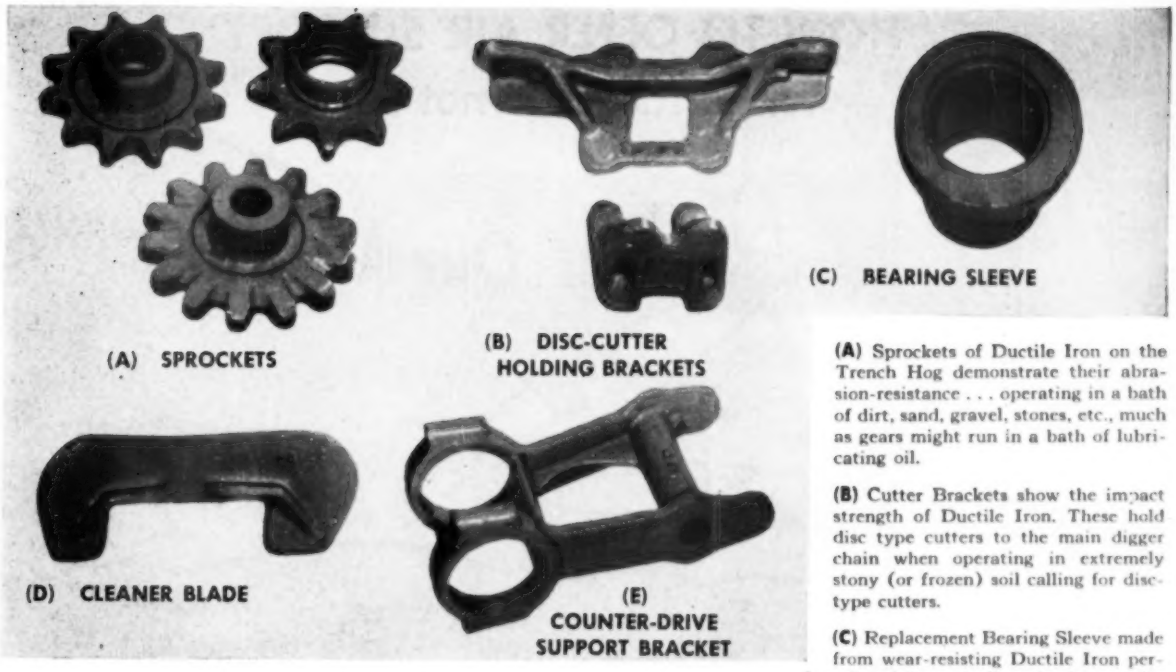

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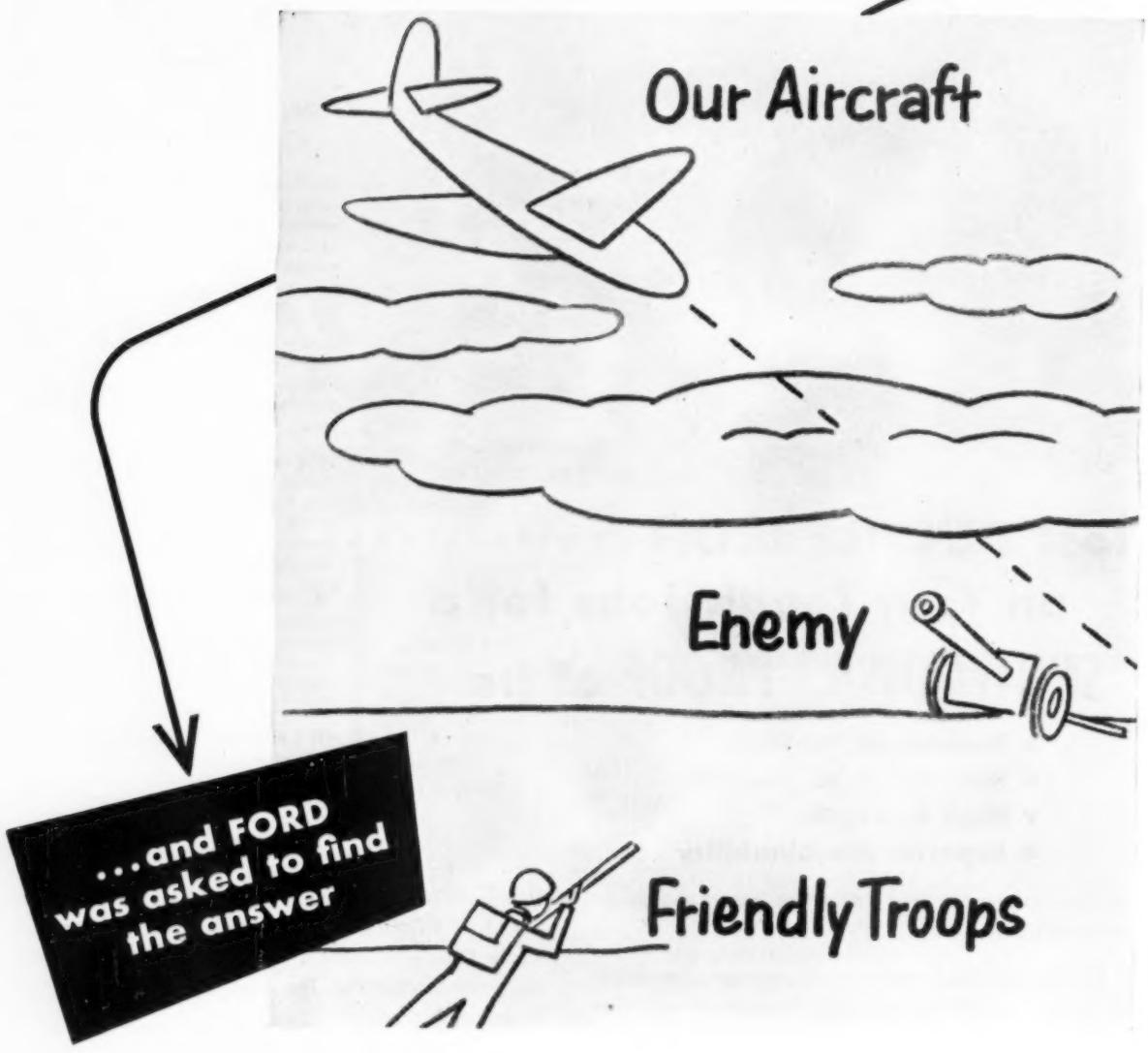

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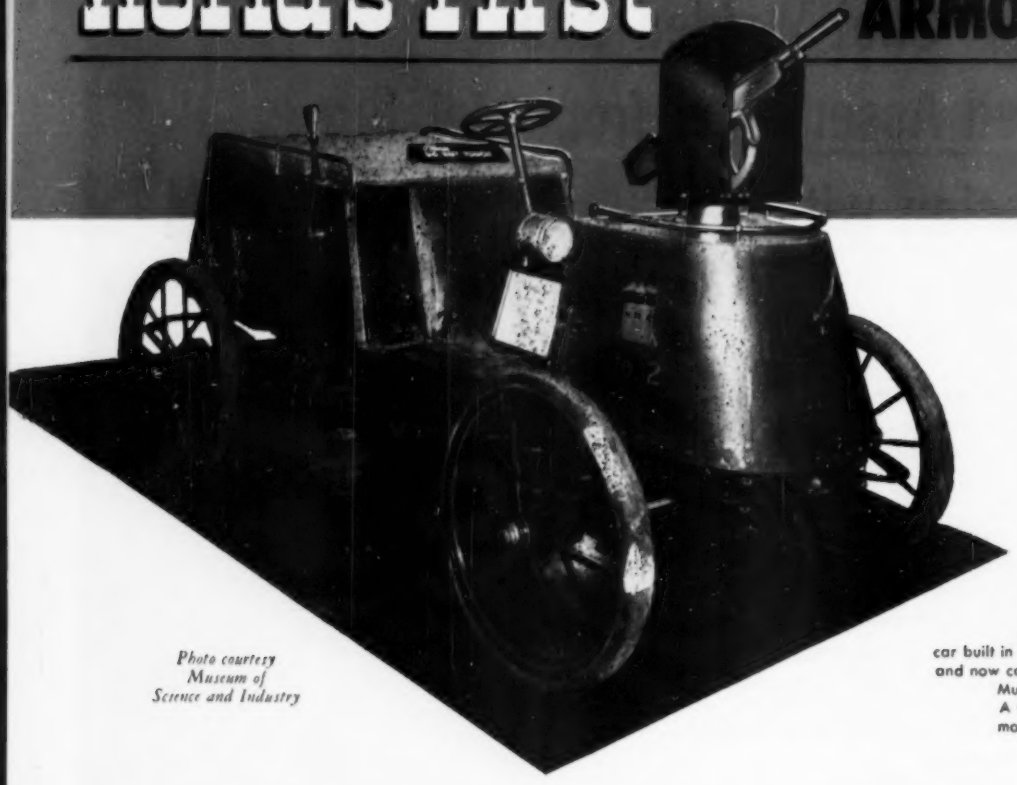

Photo courtesy Museum of Science and Industry

Mechanized warfare got its start with this steam-powered car built in 1898 by Col. Royal Davidson and now carefully sheltered in Chicago's Museum of Science and Industry. A Colt automatic machine gun is mounted behind an armor shield in front of the driver.

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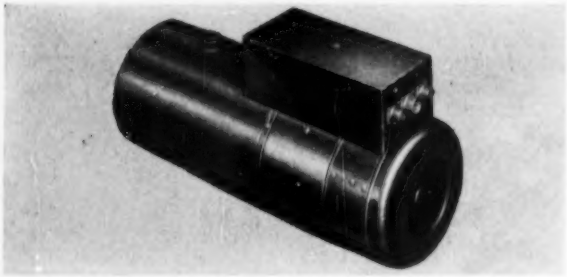
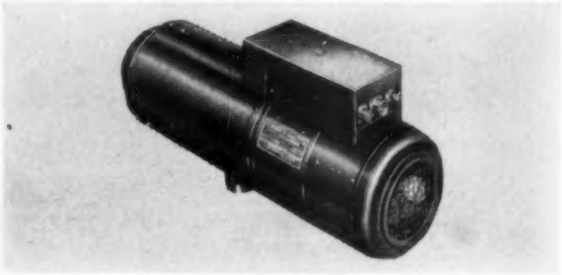
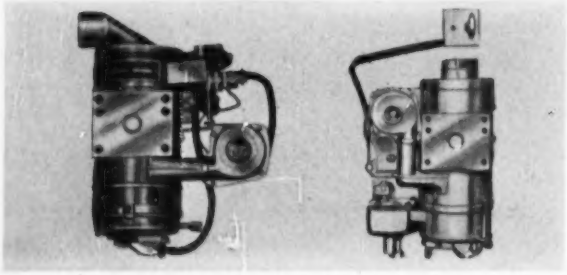


Model E-511 Coolant Heater for liquid-cooled gasoline and diesel engines. Puts 60,000 B.t.u. per hour into coolant.



Model E-510. Fresh-Air Heater. 60,000 B.t.u. per hour. Delivers more *actual fresh-air heat* than any other unit of this type. Designed for engine, cargo, personnel heating.



Series 460 and Series 590. Coolant and Direct-Fired Engine Heaters. Each heater is a complete package requiring only electric, fuel, coolant and exhaust connections.

Model E-600 Portable Heater. 60,000 B.t.u. fresh-air output. Meets the need for a complete heating unit that is easily portable. Operates on 110 V.

...they called on Perfection

The Armed Forces had to have an absolutely safe and dependable personnel heater for the hard-slugging M-48 and T-43 tanks. They had their pick of the heaters on the market but they *standardized* on Perfection Fresh Air Heaters.

They did this after rigorous tests in Perfection's own 90 below zero Cold Room and in the field *proved* that the Perfection E-500 was the safest, most dependable and efficient heater for the job.

The same practical engineering and production skills that turned out the E-500 . . . the same 11-years of uninterrupted specialization in designing complete winterization kits for all types of vehicles and equipment and heaters for personnel, cargo and engines is available to help you.

If you're building or putting equipment into service for sub-zero or Arctic operation, call in Perfection early on the project! Write for information.

Perfection Stove Company • 7390-C Platt Avenue • Cleveland, Ohio

Here's what we do:

1. Develop the winterization system.
2. Apply it to the vehicle or equipment.
3. Test it to government specifications in our Cold Rooms.
4. Prove that it meets those specifications.
5. Guarantee that the equipment will go at 65 below!
6. Make the drawings for your production, or produce the systems for you.

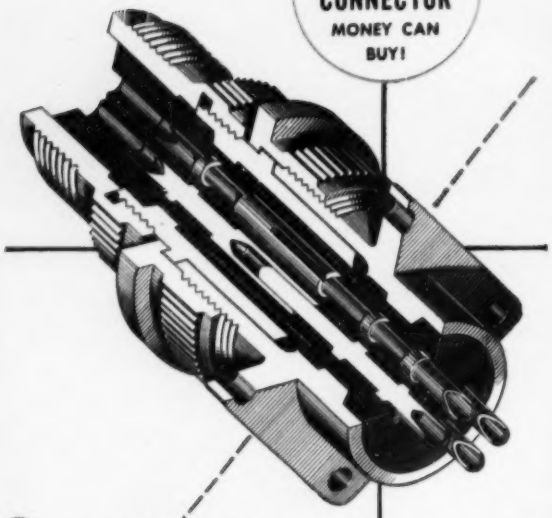
Perfection

Everything anybody needs for

PERSONNEL
CARGO
ENGINE

heating

The Finest
ELECTRICAL CONNECTOR MONEY CAN BUY!



SCINFLEX **ASSURES YOU PEAK PROTECTION AGAINST CIRCUIT FAILURE**

When operating conditions demand an electrical connector that will stand up under the most rugged requirements, always choose Bendix Scinflex Electrical Connectors. The insert material, an exclusive Bendix development, is one of our contributions to the electrical connector industry. The dielectric strength remains well above requirements within the temperature range of −67°F to +275°F. It makes possible a design increasing resistance to flashover and creepage. It withstands maximum conditions of current and voltage without breakdown. But that is only part of the story. It's also the reason why they are vibration-proof and moisture-proof. So, naturally, it pays to specify Bendix Scinflex Connectors and get this extra protection. Our sales department will be glad to furnish complete information on request.

• Moisture-Proof • Radio Quiet • Single Piece Inserts • Vibration-Proof • Light Weight • High Insulation Resistance • High Resistance to Fuels and Oils • Fungus Resistant • Easy Assembly and Disassembly • Fewer Parts than any other Connector • No additional solder required.

BENDIX SCINFLEX
ELECTRICAL CONNECTORS

Bendix

SCINTILLA MAGNETO DIVISION of SIDNEY, NEW YORK

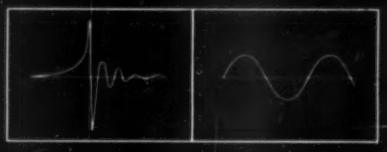
Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

FACTORY BRANCH OFFICES: 118 E. Providencia Ave., Burbank, Calif. • Stephenson Bldg., 6560 Cass Ave., Detroit 2, Michigan • Brouwer Bldg., 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

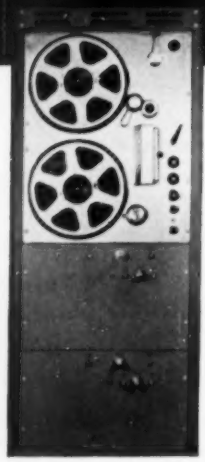
ANNOUNCING
THE AMPEX 306 DATA RECORDER

A new machine that solves more data recording problems than any new instrument since the oscillograph



Like the direct magnetic tape recorder, the AMPEX 306 presents data in "live" electrical form that can be scanned, speeded up, slowed down, automatically reduced or converted to any electrical, visual or physical form that might be desired.

But unlike any previous magnetic tape recorder, the AMPEX 306 has a frequency response down to D.C. and has high transient accuracy that is essentially independent of irregularities in the tape. The AMPEX 306 has a range, accuracy and versatility never before approached by any magnetic tape recording device.



AMPEX 306
Magnetic Tape Recorder

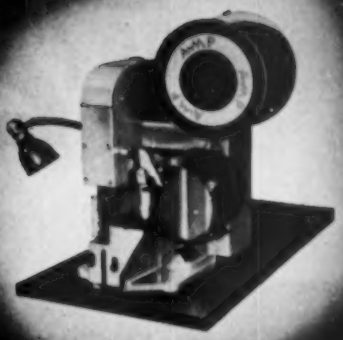
APPLICATIONS

- Recording of explosions, shock waves, geophysical data and other phenomena of a highly transient nature.
- Mechanical, physical or electrical phenomena falling in the frequency range 5000 cycles down to zero (D.C.).
- Data whose complexity and quantity makes automatic reduction, scanning or comparison desirable.
- Non-repeatable test situations requiring high reliability and comprehensiveness of data.

For further information write today to Dept. L-1039D

AMPEX ELECTRIC CORPORATION
934 Charter Street
Redwood City, Calif.

AMPEX
MAGNETIC RECORDERS



"Branded" so you KNOW it's right

AMP tools and terminals are members of a made-to-use-together team. They're made so that you can be *sure* you have a correctly installed termination. With AMP tools, the small DOT CODE "brand" gives an immediate check that the right color-matched tool has been used with the right color-matched terminal. This is just one more AMP control feature that insures the correct installation of your wire terminations day in, day out on the line—where it counts!

A-MP DOT CODE WIRE TERMINATION CONTROL

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2 IMPORTANT SYMBOLS IN

On the Firing Line . . .

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PRESSURE PROCESSING and H-P-M play an important part in the ordnance picture . . . producing a wide range of defense items from shells to parts for planes, rockets, tanks and guns. Many more, versatile H-P-Ms, today used for peacetime production, are designed so that they can be quickly converted to ordnance work with little cost or lost production time.

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AMERICA'S PREPAREDNESS PROGRAM

HPM

...On the Production Line

Cold Extrusion Presses
Shell Forging Presses
Shell Nosing Presses
Cartridge Case Presses
Hydrostatic Shell Testing Presses
Gun Barrel Straightening Presses
Armor Plate Quenching Presses
Deep Drawing Metalworking Presses
Aircraft Presses for Hidraw, Guerin and Die Quenching Processes
Die Casting Machines
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Keeping our fighting men supplied with the most of the best materiel is the job assigned to ordnance men . . . a big job vital to America's preparedness program. H-P-M has the experience and facilities necessary to offer real assistance on ordnance production problems. If you use pressure processing in your production, it will pay you well to talk shop with an H-P-M engineer today!

MANUFACTURING COMPANY

1090 MARION ROAD
MOUNT GILEAD, OHIO

ECLIPSE-PIONEER "KNOW-HOW" PAYS OFF ON ORDNANCE VEHICLES

Based on original development work by Eclipse-Pioneer, a 24-volt electrical system has been made standard on all vehicles designed for Army Ordnance.

This system pays off in three important ways. First, it *saves critical space* because it's much more compact than the old 6- and 12-volt systems of comparable ratings. Second, it's *more readily serviced* since its component parts are interchangeable with those on often-available 24-volt aircraft equipment. Third, it's *more versatile* since its design is waterproof in accord with Army standards for submerged operation.

It was quite natural that Eclipse-Pioneer should take the lead in developing and manufacturing this more efficient electrical equipment. It was quite natural because Eclipse-Pioneer is unique in possessing the necessary "know-how" and production facilities, having acquired them in developing similar equipment for the aviation industry.

Among items now being produced by Eclipse-Pioneer for Ordnance are DC Generators, Generator Control Boxes, Starters, and Starter Relays. And other precision products for Ordnance application are now in advanced stages of development.

ECLIPSE-PIONEER DIVISION OF

TETERBORO, N. J.

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

Bendix
AVIATION CORPORATION

stamping costs are going down...

DANLY PRESSES *do it!*

JEFFREY MANUFACTURING COMPANY REPORTS:

- *50% faster production*
- *200% longer die life*
- *greatly decreased maintenance*

The 200 ton Danly Autofeed Press shown here has been in continuous daily operation at the Jeffrey Manufacturing Company, Columbus, Ohio, for well over a year – *without maintenance* of any kind other than routine oil change. Steady performance like this and the faster stroking permitted by Danly's rigid, precise construction have raised average production of steel conveyor chain side bars from 3,000 per hour to 4,500 per hour.

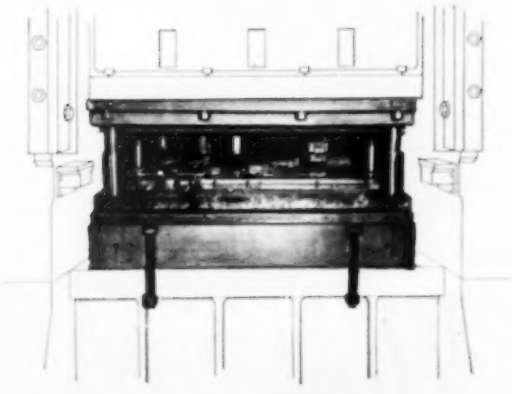
A story like this is typical of Danly Press performance in leading stamping plants throughout the country – and proof that Danly Presses reduce stamping costs!

DANLY MACHINE SPECIALTIES, INC.
2100 South Laramie Avenue, Chicago 50, Illinois

DANLY

MECHANICAL PRESSES . . . 50 TO 3,000 TONS
HYDRAULIC METALWORKING EQUIPMENT

COMPLETE OIL LUBRICATION—INCLUDING GIBS
Automatic oil lubrication of gibs permits extremely close alignment of slide and more accurate guiding of dies—greatly decreasing die wear. Clean filtered oil continuously supplied to all wear surfaces is only one of Danly's outstanding "preventive maintenance" features.



DIE LIFE TRIPLED!
In the setup shown here, alloy steel side bars 5/16" thick are blanked and punched in a multiple stage die at a high rate of speed. Dies like these last 200% longer in Danly Presses. In one case, dies formerly producing 10,000 pieces are now producing 30,000 pieces before grinding is necessary.

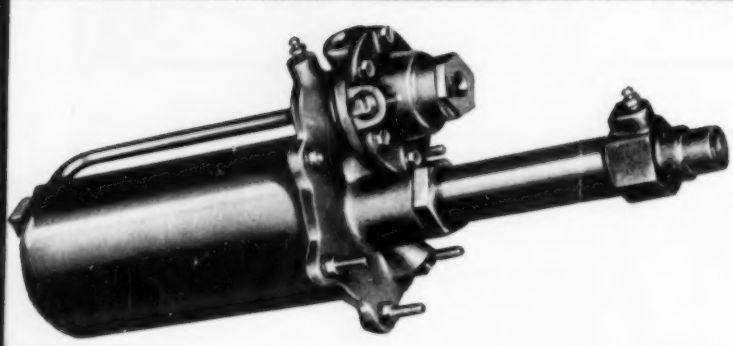
It costs less to run a DANLY PRESS!

Single Action Straight Side | Autofeed | Underdrive Single, Double Triple Action | Gap Frame | Double Action Straight Side

Bendix

AIR-PAK

combines the advantages of air power with hydraulic brake actuation



Here, with a single compact, easy-to-install power braking unit, truck manufacturers and operators can combine all of the well proven advantages of hydraulic brake actuation with an air brake system.

Bendix® Air-Pak changes air pressure into hydraulic pressure by means of two directly connected pistons. Thus, a non-compressible column of brake fluid instead of air connects between the driver's foot and the brake shoe. The result is faster brake action, more positive and better control.

Another important Air-Pak advantage is the fact that brakes can be applied instantly by foot power alone—an emergency standby when braking is required before air pressure builds up, or if air pressure fails for any reason.

Important, too, is the fact that Air-Pak is a product of Bendix, designer and builder of Hydrovac®, the world's most widely used power brake with over three million units now in use.

Thus Air-Pak benefits from a specialized engineering and manufacturing experience unrivalled in the automotive industry.

Descriptive folder on Air-Pak is available on request.

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THE MOST TRUSTED NAME IN BRAKING

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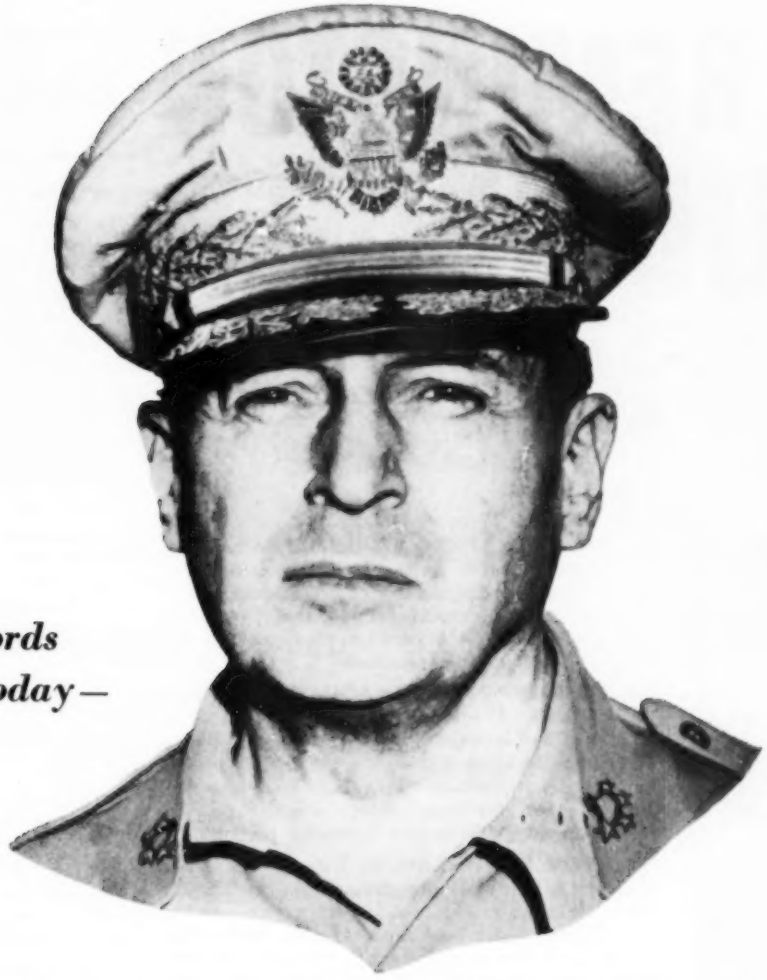
Bendix AVIATION CORPORATION

Bendix Products Division



Guide words for today—

"In the mighty and almost limitless potential of American industry—the brilliance and rugged determination of its leaders; the skill, energy and patriotism of its workers—there has been welded an almost impregnable defense against the evil designs of any who would threaten the security of the American continent. It is indeed the most forceful and convincing argument yet evolved to restrain the irresponsibility of those who would recklessly bring down upon the good and peace-loving peoples of all the nations of the earth the disaster of total war."

—DOUGLAS MacARTHUR

Tyrant nations are deterred from aggression not only by our armed forces . . . but by the tremendous "potential of American industry" of which General MacArthur speaks.

Until the world finds lasting peace, military preparedness is clearly necessary. But our greatest need is to preserve the freedom of opportunity and enterprise which made possible our industrial power. Freedom is our strength . . . our greatest resource . . . our hope for the future.

W B Stewart
President

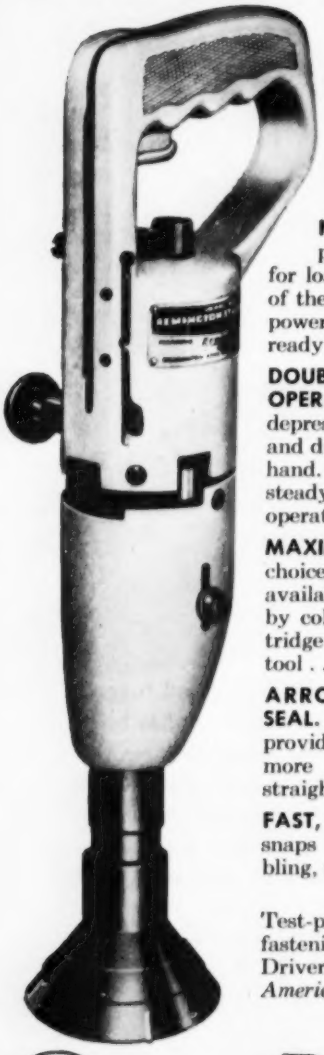
DUTY HONOR COUNTRY
LABOR BUSINESS GOVERNMENT

The Gray Manufacturing Company, Hartford 1, Connecticut

Makers of Audograph and PhonAudograph Electronic Soundwriters

AND GRAY RESEARCH AND DEVELOPMENT CO., INC., Specialists in Video, Audio, Sub-Audio Electronic Mechanisms

MODEL 450 REMINGTON STUD DRIVER



—the ONLY powder-actuated fastening tool with ALL these advantages—

NO ACCESSORIES REQUIRED. No separate parts needed to control power, none required for loading—nothing to lose or break. Just a twist of the wrist opens the Model 450. Insert stud and power cartridge as a unit . . . close and you're ready! Whole job takes seconds.

DOUBLE-SAFE—REQUIRES *BOTH* HANDS FOR OPERATION. A separate safety lever must be depressed and *held* that way with one hand before and during squeezing of the trigger with the other hand. Safe, two-handed operation holds the tool steady. Two *additional* safety devices prevent operation except in proper fastening position.

MAXIMUM POWER RANGE. You get a wide choice of power in Remington cartridges. They're available in six different loads, each clearly marked by colored plastic heel caps. The 32 caliber cartridge gives you extra power in this medium-duty tool . . . helps you speed all types of fastening jobs.

ARROW-STRAIGHT DRIVING—PERFECT GAS SEAL. Long heel cap on all Remington cartridges provides tight gas seal . . . gives the Model 450 more power. Assures controlled, consistently straight driving.

FAST, POSITIVE EJECTION. Exclusive ejector snaps fired case out of tool instantly—no fumbling, no tools needed.

• • •

Test-proved to be the world's finest and speediest fastening system, the Model 450 Remington Stud Driver is made by Remington Arms Company, Inc., *America's oldest sporting arms manufacturer.*

"If It's Remington—It's Right!"

Remington DU PONT

Listed & Approved by Underwriters' Laboratories, Inc.

NEW, FREE BOOKLET shows you a hundred different ways the Model 450 Remington Stud Driver can speed *your* construction fastening. Packed with illustrations, it tells you where and how this tool can save time, reduce fatigue and cut costs. Send in the coupon for your copy.

MAIL THIS COUPON TODAY

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Remington Arms Company, Inc.
939 Barnum Ave., Bridgeport 2, Connecticut

Please send me my free copy of the new booklet showing how I can cut my fastening costs.

Name .....
Position .....
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ATOMIC ENERGY

NEW ATOMIC PLANT

The United States Atomic Energy Commission has selected a site eighteen miles east of Macomb, Ill., on the Spoon River in Fulton County, for a new explosives-processing and assembly plant. The new plant will not manufacture radioactive material.

Transfer of approximately 9,800 acres of Government-owned land on the former site of World War II Camp Ellis is being made to AEC by the General Services Administration. The U. S. Air Force has been using most of the land for a survivor-training area, and about 800 acres have been held by the Department of Army for use by the Illinois National Guard. Both the Air Force and the Army have indicated their willingness to give up the land.

Only about 900 acres of the land required for the AEC site will be taken from the 6,400-acre area planned for release by the General Services Administration to private purchasers. The new AEC plant, to be named the Spoon River Plant, will cost about $29,000,000.

UNIQUE CYCLOTRON

Details of a new cyclotron at Oak Ridge National Laboratory, the first and only cyclotron specifically designed to accelerate heavy particles, have been announced by Union Carbide and Carbon Corporation, operators of the laboratory for the Atomic Energy Commission. The new cyclotron, a 63-inch type, has made possible the fusion of light elements to form heavier elements, and thus opens a whole new field of fundamental research in nuclear physics.

In heavy-particle acceleration, nitrogen ions are accelerated to an energy of 25 million electron volts (Mev), and with this energy it is possible to bring about the nuclear fusion of elements. Nitrogen nuclei are forced to combine with nuclei of such elements as oxygen and carbon to form the heavier nuclei of fluorine, sodium, and aluminum.

The nuclear-fusion reactions obtained are in some ways the reverse of nuclear fission. In the fission of a uranium atom, the large nucleus breaks into two smaller nuclei and several smaller particles (neutrons). These fragments fly apart with great velocities, releasing a considerable amount of energy.

In the case of fusion, energy is supplied to drive one nucleus into another, and the two combine to form a larger nucleus, and several small particles (usually protons or alpha particles) are given off. It is not expected, however, that the fusion reac-

OPERATOR REPORTS

Production up — Maintenance down

Twenty of these Allison TORQMATIC-equipped trucks are working 21 hours a day hauling 34-ton pay loads of coal and overburden over 7½% grades.

The Wadesville Production Company operates 20 Allison TORQMATIC-equipped Euclid rear-dump trucks hauling 42,000 tons daily in its strip mine near St. Claire, Pa. These trucks boost production by making round trips 25% faster than the mechanical-drive units they replaced.

This operator's records show TORQMATIC DRIVES outlast mechanical drives — maintenance time and costs are down too. At routine overhaul periods, mechanics change out the TORQMATIC DRIVES in 2 hours less time than they change out a mechanical drive.

You, too, can cut your heavy-duty equipment operating costs by specifying Allison TORQMATIC DRIVES the next time you buy. Ask your equipment dealer, manufacturer or write:

ALLISON *Division of* GENERAL MOTORS
Box 894-OO, Indianapolis 6, Indiana

ALLISON TORQMATIC DRIVES

Unbeatable Team for Maximum Operating Economy

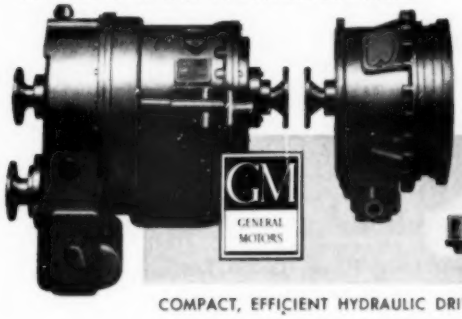
**Quick-shifts* at full throttle with fingertip hydraulic control.

**Holds* power to load at all times — no clutch pedal to push—no gearshift guess.

**Cuts* maintenance cost by absorbing shock — eliminates engine lugging — prolongs equipment life.

**Only* torque converter-transmission team designed to work as a unit and built by one manufacturer.

MATCHED UNITS BUILT BY ONE MANUFACTURER



Allison TORQMATIC DRIVES

COMPACT, EFFICIENT HYDRAULIC DRIVES FOR CRANES * TRUCKS * TRACTORS * SHOVELS * SCRAPERS * DRILLING RIGS

. . . HAVE ADVANTAGES IF YOU ARE PRODUCING MILITARY SPARE PARTS OR SUPPLIES.

MIL-C-12147 MIL-C-5405 DAPD-P-154

The advantages to you include lower packaging costs in that less labor is required on the assembly line and, in most instances, increased output results. Closing equipment is available on a rental basis.

The advantages to the military include a continuous barrier for each completed package. This offers maximum protection against mechanical failure in service handling, and with a minimum of error due to the human element in packaging operations.

Spare parts and supplies packaged in cans made under MIL-C-12147, MIL-C-5405 and DAPD-P-154 meet all the requirements of Method 1A and Method 1C, Unit Packaging, under MIL-P-116A. This packaging is approved and currently in active use by most of the technical branches of the service.

In addition, there is a growing acceptance for the use of these containers in many civilian applications.

Write or call us regarding any packaging problems confronting you at this time. We will provide the technical help.

The CLEVELAND CONTAINER Co.

6201 BARBERTON AVE. CLEVELAND 2, OHIO

• All-Fibre Cans • Combination Metal and Paper Cans
• Spirally Wound Tubes and Cores for all Purposes

PLANTS AND SALES OFFICES: Cleveland, Detroit, Chicago, Plymouth, Wisc., Jamesburg, N. J., Ogdensburg, N. Y. • ABRASIVE DIVISION at Cleveland SALES OFFICES: Grand Central Terminal Bldg., New York City; Washington Gas Light Bldg., Washington, D. C.; West Hartford, Conn.; Rochester, N. Y. Cleveland Container Canada, Ltd., Prescott, Ontario • Offices in Toronto and Montreal

Atomic Energy

tions produced in the cyclotron could be sustained as a chain reaction.

NEW AEC LABORATORY

A new Atomic Energy Commission laboratory located in Winchester, Mass., is now in full operation. The primary objective of the laboratory, operated by the American Cyanamid Company under contract to the Raw Materials Division of the AEC, is the development and improvement of processes for the recovery of uranium from its ores.

The new laboratory is well equipped for studying all phases of mineral dressing, and one of its functions will be to undertake the vitally important task of developing methods for effective and economical recovery of uranium from low-grade ores and other low-grade uranium-bearing materials.

The laboratory was started at the Watertown (Mass.) Arsenal in 1945 under the direction of Dr. A. M. Gaudin, professor of mineral engineering of the Massachusetts Institute of Technology. At that time the contract with the Atomic Energy Commission was with M.I.T. which built up the staff from a few people to a total of about sixty. During this period the laboratory made a number of extremely valuable contributions to process development for uranium recovery.

As the demand for uranium increased, the scope of the operations of this laboratory became broader and eventually resembled the development function of regular commercial metallurgical testing facilities. M.I.T. decided it should no longer carry on the operation of the laboratory, since it involved work more of a commercial nature than that normally handled by an academic institution. Consequently, in 1950, the American Cyanamid Company was awarded the contract to operate the facility. The operations continued at Watertown until December 1952.

LOW INJURY RATE

The injury rate in the Nation's atomic-energy program decreased by one-third in 1952, the U. S. Atomic Energy Commission announced recently. Injuries in the program during 1952 occurred at a rate of 2.51 per million employee-hours—33.3 per cent below the 1951 figure. The rate for all United States industry in 1951, the latest available from the National Safety Council, was 9.06 injuries per million employee-hours. A breakdown of the 1952 safety figures follows:

1. Operations contractors in the atomic-energy program set a rate of 2.29 employees injured per million man-hours, compared with 2.69 in 1951. The N.S.C. 1951 rate for the chemical industry, the nearest comparable, was 5.48.

an easy way to cut your production costs

OILITE does it—
with FINISHED MACHINE PARTS

machining this segment costs ..... $.70

OILITE segments cost ..... $.08

machining this segment costs $1.30

OILITE segment cost ..... $.07

Other Advantages Include:

- No investment in machine tools
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- Releases skilled manpower to other jobs
- No material supply problems

FIELD ENGINEERS AND DEPOTS THROUGHOUT UNITED STATES AND CANADA

Oilite Products Include: Bearings, Finished Machine Parts, Cored and Solid Bars, Permanent Filters and Special Units.

VITAL ELEMENT
in the development of the ENIAC

■ Electronic computers function in the design and operation of military, defense and industrial equipment.

■ Magnetic memory and coincident current apparatus are integral and essential components in many electronic computers.

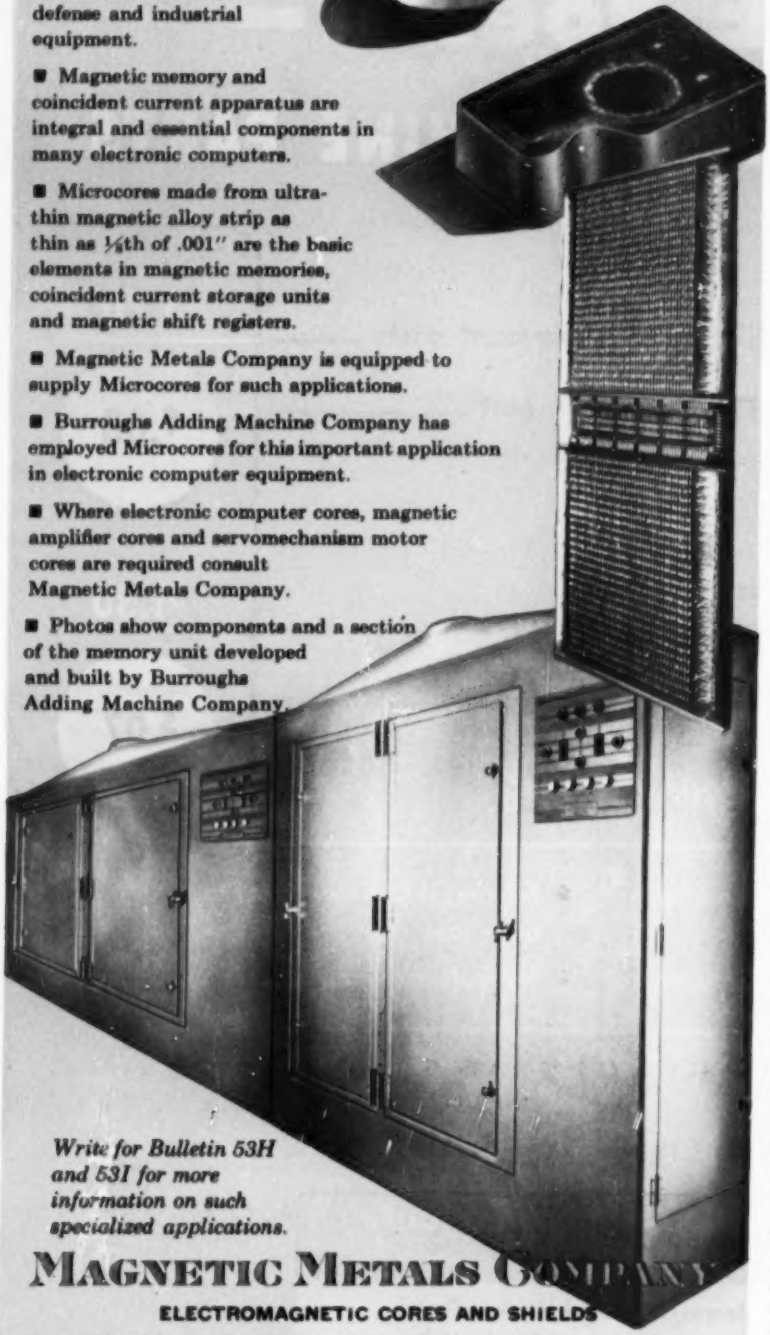
■ Microcores made from ultra-thin magnetic alloy strip as thin as 1/5th of .001" are the basic elements in magnetic memories, coincident current storage units and magnetic shift registers.

■ Magnetic Metals Company is equipped to supply Microcores for such applications.

■ Burroughs Adding Machine Company has employed Microcores for this important application in electronic computer equipment.

■ Where electronic computer cores, magnetic amplifier cores and servomechanism motor cores are required consult Magnetic Metals Company.

■ Photos show components and a section of the memory unit developed and built by Burroughs Adding Machine Company.



Write for Bulletin 53H and 53I for more information on such specialized applications.

MAGNETIC METALS COMPANY

ELECTROMAGNETIC CORES AND SHIELDS

HAYES AVENUE AT 21st STREET • CAMDEN 1, N.J.

Atomic Energy

2. With an 80 per cent increase in construction man-hours in 1952, workers incurred a construction-injury rate of 2.71, which was 47 per cent lower than the 1951 rate. The N.S.C. rate for all 1951 construction was 20.92.

3. AEC direct employees had 1.96 injuries per million man-hours in 1952, compared with 1.95 in 1951. The rate for all Federal civilian employees for 1951, issued by the Bureau of Employees' Compensation, Department of Labor, was 8.4.

4. The rate for Government-owned motor vehicles was 1.4 accidents per 100,000 miles driven by employees of AEC and its contractors in 1952, compared with 1.6 in 1951.

5. Fatalities likewise were reduced, dropping from 24 in 1951 to 11 in 1952. None was due to radiation. Nine occurred in construction, one in a motor-vehicle accident, and one in loading a heavy generator which fell. The program rate for fatal injuries was 7.6 per 100,000 workers in 1952, compared with 23.2 in 1951. The N.S.C. rate for all U.S. industry in 1951 was 27.

6. Industrial fire losses of Federal property in the atomic-energy field increased to $448,236 in 1952 against $38,318 in 1951. Two fires accounted for $362,000 damage. The 1952 fire loss was 1½ cents per $100 of property held. Improved-risk industrial properties nationally had a loss rate of 2¾ cents in 1951.

Important contributors to the personnel safety record of the atomic-energy program were thirty contractors and three AEC field offices which have worked without disabling an employee in the past two years.

BIKINI PROVING GROUND

To accommodate the rapidly expanding program of developing and testing new and improved nuclear weapons, the United States Atomic Energy Commission is enlarging the Pacific Proving Ground in the Marshall Islands to include Bikini as well as Eniwetok Atoll. Bikini is 180 miles to the eastward of Eniwetok.

Use of Bikini is necessary because of the limited size of Eniwetok, where tests were conducted last November. Eniwetok will be the headquarters and main operating base for the proving ground. Bikini and Eniwetok will remain under the civil jurisdiction of the Department of Interior. AEC uses the area under agreement with Interior. Bikini was last used in 1946 for testing military effects of conventional atomic bombs.

The United Nations is being notified by the Department of State that Bikini Atoll and its territorial waters have been closed for security reasons in accordance with the provisions of the Trusteeship Agreement between the U.S. and the United Nations Security Council.

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*Awarded seven "E's" for Excellence during World War II

Experienced Leadership

John Slezak Appointed Assistant Secretary of the Army

ALL members of the Industry-Ordnance Team rejoice in the selection of one of its most distinguished leaders for one of the Army's most difficult assignments.

The Defense Act of 1920 envisaged an experienced manufacturer in the post of the Assistant Secretary of War, but very few men who have held this pivotal office have had that qualification.

However, an experienced ordnance leader is, at long last, now at the helm.

Col. John Slezak, Assistant Secretary of the Army (Matériel), whose photograph appears on the front cover of this issue, served in both World War I and World War II and is an outstanding industrial leader.

Many Qualifications

Colonel Slezak possesses many military and industrial qualifications. He enlisted in the Army in 1918 as a private and was separated from the Army in 1919 as a private.

He entered the Ordnance Reserve in 1924, shortly after completing his education at the University of Wisconsin, and his tours of active duty included assignments in the Training Division of the Office of the Assistant Secretary of War and, a few years later, in the Machine Tools Division. His ability and devotion to duty merited for him promotion through the years from second lieutenant to colonel.

In 1947 Colonel Slezak became a director of the American Ordnance Association and made many significant and lasting contributions to the solution of problems that required both an intimate first-hand knowledge of military requirements and industrial capacity.

Unusual Competence

He is widely known in the military and industrial fields for his sure grasp of realities, his unusual competence, his genial modesty, his dedicated and self-sacrificing patriotism, and his immense driving power in the efficient discharge of national military and industrial responsibilities.

Prior to assuming his present post, Colonel Slezak was not only the head of many manufacturing concerns and a director of many important corporations, small and large, but he was chosen to represent his business associates in such organizations as the Illinois Chamber of Commerce, the Illinois Manufacturing Association, and the National Association of Manufacturers.

He is also a trustee of the Illinois Institute of Technology yet he still found time and energy to serve his home-town community of Sycamore, Ill., as president of its board of education and as a commissioner on its recreational board.

Chief of Chicago District

During World War II Colonel Slezak helped to organize the Machine Tool Division of the Army-Navy Munitions Board, but his most memorable service to his country was as chief of the Chicago Ordnance District during that conflict.

During the month of April 1945, one month before V-E Day, the Chicago Ordnance District, under Colonel Slezak's expert direction, was dealing with 723 prime contractors. The number of prime contracts and purchase orders under administration was 3,189 and had a value of $3,609,537,205. During the same month of April 1945, 683 new contracts were awarded, valued at $297,988,710. The total number of civilian and military personnel in the district was 5,287.

Underlining the importance of the Ordnance district system, Lieut. Gen. Levin H. Campbell in his book, "The Industry-Ordnance Team," wrote:

"This gigantic production (in World War II) was possible only through the decentralization of gigantic responsibilities to our Ordnance Districts. The great men and women of the districts have their glorious share in the remarkable war achievement of a free and united people."

Won Legion of Merit

Colonel Slezak was awarded the Legion of Merit in 1944 for outstanding service with the Army-Navy Munitions Board and the Chicago Ordnance District and an Oak Leaf Cluster to the Legion of Merit in 1946 for distinguished service as chief of the Chicago District.

He was nominated by President Eisenhower as Assistant Secretary of the Army on April 6, 1953. His nomination was confirmed by the Senate on April 30th, and he was sworn into office on May 4, 1953.

Colonel Slezak is a big man in a big job. Throughout the Nation he is a symbol of loyalty, integrity—and hard work. His host of friends in the Association wish him every success and good fortune in his new post.

And with his extensive background of industrial knowledge and military experience, that success seems to be very well assured.

"ROCKETS AWAY!" *is the watchword as this Republic F-84F Thunderjet swept-wing fighter looses a salvo in preparation for ground support of our troops in Korea (Air Force photo).*

The Need for Integrated Research

Weapons Must Keep Pace with the Vehicles That Bear Them

John F. Floberg

Assistant Secretary of the Navy for Air

THE naval service is a complicated one—far more so than any other and infinitely more so than most Americans appreciate. To most of our fellow citizens the sea is a distant, trackless, and mysterious expanse which they do not understand and which they are perfectly satisfied to leave to the relatively rare individual who chooses the life of the mariner.

To those who reflect upon it, however, the sea becomes the avenue of ingress to and egress from all corners of the world for most peoples of the world for their national purposes, be those purposes good or bad.

Avenue for Materials

To those of you who are engrossed in industry the sea is the avenue for delivery of the critical raw materials upon which your industry thrives.

To you, names like manganese, chromite, cobalt, rutile, aluminum, columbium, kyanite, tin, lead, zinc, uranium, asbestos, tungsten, copper, and many others are far from just names in the atomic table or curiosities in some laboratory.

To the military services the sea is the route for transportation to the battle area for as long as conflicts are contained in areas away from our shores, and it is the source of support for all overseas-based forces.

To the Nation as a whole the sea is the basis of a sound national economy and the highest standard of living. . . .

To the Navy it is all these things and many more. It is the kind shelter from which our submarines can launch highly destructive attacks against either enemy ships or an enemy land; and reciprocally it is the lair in which the enemy submarine can hide while preparing his onslaught or in which he can take refuge after he has delivered it.

Mr. Floberg delivered these remarks at the New England Regional Meeting of the American Ordnance Association held in Boston, Mass., on May 8, 1953.

It is the three-fourths of the earth's surface from which the ubiquitous air power of the Navy can launch the most devastating forces that modern science has been able to assemble in an ordnance package. We may thank our lucky stars that this capability is an American monopoly. . . .

It is the broad expanse where convoys of men and materials must be guarded from point of origin to point of destination, and it is the target area from which enemy shipping must be driven in time of war.

It is the battlefield where brave men live and fight, and die and it has been these things, with variations in the weapons, for centuries and will continue to be so for long after our time. The weapons and the nature of the ships and their immediate tasks have changed and will change, but the world's geography is immutable, and so the fundamental nature of the problems will never alter.

The complexity of her environment

makes it impossible for the Navy ever to be a single-purpose or a single-weapon force. In keeping pace with technology she has endeavored to exploit all the progressive trends in the basic and applied sciences —and must continue to do so, in my opinion, with increasing vigor.

Irrespective of the scientific field in question, no effort may be spared to integrate all possible scientific advancements in both existing and newly developed weapons which can be efficiently and effectively used in prosecuting the naval mission.

A combat vehicle of land, sea, or air which mounts poor ordnance is necessarily a poor tool of war. Conversely, good ordnance mounted on a poor weapon carrier will never create a good tool of war. No compromise in quality is acceptable in either the vehicle or the ordnance, and I firmly believe that it is imperative that each be considered in its proper perspective.

Habitually the analysis of existing or proposed weapon capabilities assumes the form of a description of the performance characteristics of the weapon-bearing vehicle. A ship or aircraft travels at a speed of so many knots or with a combat radius of so many miles, or endurance of so many hours or days, or an altitude or a submerged depth of so many feet, and a tank travels at so many miles an hour and is served by a crew of so many men, etc. These are usually dramatic and readily comprehensible figures to the layman and consequently have considerable popular understanding.

The importance of the ordnance component, however, which represents the lethal effectiveness of the particular vehicle, is generally not recognized in perspective proportionate to its importance to the weapon system because it is more likely to be readily comprehensible and interesting only to the specialist.

Proportionate Results?

In consideration of the relative emphasis applied to ordnance as compared with ordnance-carrying vehicles, it always worries me whether we are supporting ordnance research and development to the appropriate degree and especially whether we are getting proportionate results. I also frequently wonder whether appropriate consideration is given to a number of factors

which present hazards in the attainment of effective ordnance of quality.

Among the most important of these hazards are: (1) failure to appreciate the relative importance of good ordnance toward successful mission accomplishment by the integrated weapon system; (2) improper consideration or lack of consideration for appropriate time phasing of ordnance research relative to vehicle research; (3) lack of realism of ordnance requirements and specifications; (4) penalties imposed on ordnance research, development, and production because of the high degree of specialization of such work and the lack of a prominent peacetime civilian industrial counterpart.

All these hazards are related and all are directly reflected in the quality of weapons produced.

Lack of Perspective

Some of the subordination of ordnance relative to weapon systems as a whole may be attributed to the lack of proper perspective of the relative importance of the vehicle and the ordnance. In every phase of research, development, and production of the complete system there must be an appreciation of the need for the reliable and efficient ordnance essential to carry out the military mission.

It is perfectly true that an aircraft engine is the heart of an airplane and that no airframe regardless of its performance potential is of any value without a reliable engine delivering the requisite energy. It is equally true, however, that without reliable and effective ordnance the same airplane would be better off never to take to the air.

The subordination of ordnance to the more glamorous aspect of vehicle performance is particularly prevalent and also particularly dangerous in the aircraft field. Although the vehicle is here accepted as the representative of the final product of the weapon system and the assemblage of many components and the culmination of incalculable skill and effort, it is worth little unless the proper recognition and appreciation have been afforded to its ordnance components.

One of the major problems of concern to all of us in the military departments at the present time is that of time-phase relationship between vehicles and essential system components, including ordnance, measured both on research and development and on production time scales.

An outstanding example of this difficulty experienced during the past couple of years in the aircraft industry has been the lack of concurrency between airframe and engine production. This critical problem is an outstanding example of the danger which is faced in releasing an aircraft to production while the components required to make it a usable weapon are still undergoing development.

Obviously the airframe designer must be able to assume he will have a realistic engine with performance characteristics predictable with accuracy.

The same relationship exists between the carrying vehicle and its ordnance. Ordnance components must be designed ahead of the vehicle in order that their design and performance characteristics are available for use by the vehicle designer, but there have been, I am sorry to say, a good many examples where ordnance has not matched the vehicle either timewise or performancewise.

Each of the services can point to a good many cases in which ordnance design has lagged behind vehicle design and where rapid progress in the vehicle has forced the utilization of off-the-shelf ordnance components known at the time to be either inadequate or obsolescent.

> **"The naval service is, of course, vitally interested in the prosperity and health of this organization [the A.O.A.]. The Navy and the Marine Corps are, and always have been and always will be, qualitative rather than quantitative services; and the inevitable consequence of that fact is the corollary that progress is the most important commodity which they buy. Reciprocally, progress is to my mind the most important commodity which your Association can furnish us."**
>
> —Secretary Floberg

Ordnance designers and specialists must concentrate more than in the past on future vehicle performance capabilities and they must make every effort to phase ordnance development programs so that modern ordnance components will be available when needed. We can neither be satisfied nor can we accept penalties imposed on our most modern vehicles if we have to accept relatively ineffective ordnance.

Difficult To Explain

The fact that bombs of obsolete shape must be carried on modern high-speed aircraft is difficult to explain to an airframe designer who has striven for years to obtain incremental increases in aircraft speeds, and even more difficult to explain to pilots whose combat achievements and very lives are placed in jeopardy by their own ordnance equipment.

In this connection, it may be pointed out that a bomb shape that reduces the maximum speed of an airplane by twenty knots in effect jettisons a year of progress in aircraft design, where the curve of current progress shows roughly twenty knots per year advance in performance.

Few Short Cuts

I am as conscious as any one that there are few short cuts in effective research and development. Their time scales cannot be unrealistically compressed, and it is delusive to assume that such compression can be accomplished merely in order to achieve concurrency between related vehicles and their component schedules. A better job must, however, be done in the future on this problem than has been done in the past, and the people who can do it are in this room.

During recent years the military services have been increasing the stringency of their specifications more and more in order to keep equipment abreast of current technological trends and the ever-rising scale of operational requirements.

Specifications are continually scrutinized and modified to insure adequate performance of vehicles and ordnance at higher speeds, higher altitudes, longer ranges, and in extreme environ-

mental conditions. The resulting specifications present challenging and sometimes nearly insurmountable obstacles to the designer.

The consequent complexity trend of components which is further compounded as these components are integrated into the weapon system has precipitated both ordnance and the vehicles that carry them to alarming weights and sizes.

Performance Sacrificed

This trend has brought sacrifices in performance and has necessitated compromise in other essential factors of reliability and operational effectiveness. I believe that a consciousness of the danger presented by this trend has been stimulated in some circles, particularly in the airframe and some component segments of the aircraft industry.

To some extent this may also be true of the aircraft ordnance industry, but if so the consciousness has not been nearly as complete as it should be. It is about time, in my opinion, that the ordnance industry devote a lot more attention than in the past to this specific issue.

The airframe manufacturers are devoting great attention to methods of saving a few cubic inches here or a few ounces there in order to increase the performance of the airplane and its consequent capability to perform its military mission. But they are frequently faced with the squandering of space and weight in the terms of cubic feet here and pounds there by ordnance and electronic equipment.

As performance continues to increase in aircraft, the people in this room and the organizations they represent are going to have to increase their efforts to eliminate this extravagance.

Corresponding Obligation

I am well aware that there is a corresponding obligation on the military services to reëvaluate continuously the specifications and design features on the basis of realistic requirements of the particular vehicle or weapon. Performance characteristics of all weapons should be based only on design criteria imposed by a realistic appraisal of actual operating requirements.

With proper recognition of this theorem by the military services and diligent application to the problem by industry, I believe and hope that the present alarming growth and complexity trend can both be halted and reversed. . . .

Ingenuity will be in great demand to accomplish this end, but it must be exercised within a philosophy which considers design factors of minimum weight and size, simplicity and reliability to be of importance second to nothing and to be the ingredients of overall combat performance.

Hazard Minimized

The hazard of overspecialization in the ordnance field has been somewhat minimized during recent years because of our engagement in both hot and cold wars. There is a tendency in the overspecialization direction, however, as a result of the fact that ordnance has been isolated as a special field restricted to military agencies and also to those industrial concerns that were able and willing to indulge in a feast-or-famine type of business.

Except for those who have actually seen war at first hand or have participated in ordnance research or production phases, there are many mysteries associated with the use of our weapons. This is one of the reasons that the lay mind habitually fails to attach to ordnance the importance which it deserves. . . .

There is also in this day of so-called "deterrent weapons" (a compliment sometimes paid by enthusiasts to the atomic bomb) some doubt concerning the actual need for the hundreds of other weapons of considerably less glamor and sophistication.

The fallacy in this thinking cannot be overemphasized, for national defense in this country requires efficient weapons of many kinds to meet our needs for either cold war or hot war strategy.

The conclusion of these thoughts is that increasing emphasis and appreciation must be given to ordnance research leading to more efficient weapons having a potential for all the military services. In the research stage, I believe there should be no discrimination between weapons of a particular type or between those of specific application primarily by one service.

Research processes cannot be effective and still be restricted in concept or in utilization of basic scientific technology. To attempt to do so imposes a throttling effect on weapons research in both the basic and the applied form.

Likewise, design, application, or use of a particular weapon or type of ordnance cannot be restricted to individual services or else a degree of compartmentation which will operate to the detriment of the team as a whole would be inevitable.

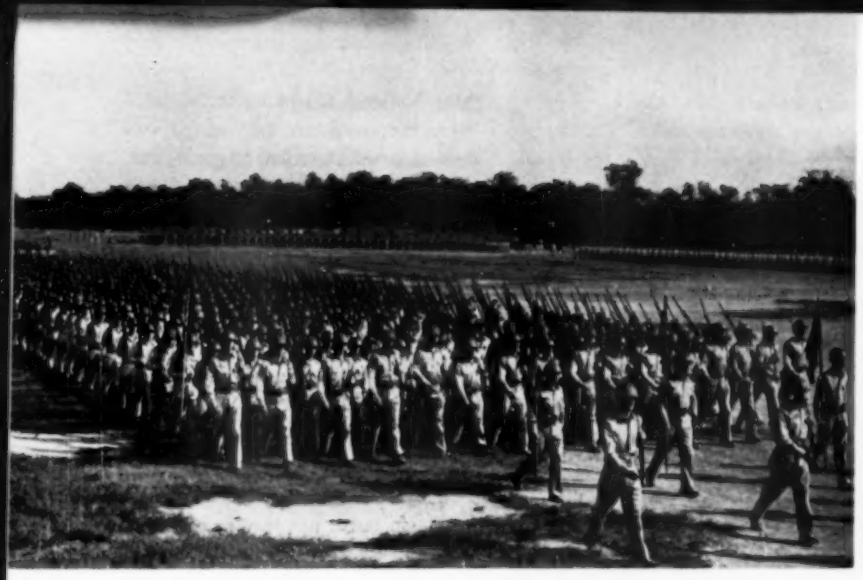
Military effectiveness and potential achievements in any war which may be thrust upon the United States can only be determined in terms of a weapon efficiency which represents the end product of a unified national military effort. Consequently, greater attention must be given to weapon development in terms of weapon-system approach than in the past, but still always with proper emphasis applied to the major components of the weapon.

Major Components

This objective means consideration of major components such as the weapon carrier, its propulsion and its ordnance, each viewed in its proper perspective but each essential to successful mission accomplishment.

This perspective also includes appreciation and recognition of the necessary measures of support, both financial and time-phasing elements, which must be applied to all pertinent fields of scientific or production endeavor.

No single weapon nor type of ordnance, however revolutionary in design, can be expected to be the solution of all military campaigns or all problems in military strategy. Our national effort and economy are capable of fostering, and must be made to foster, a healthy weapons-research program correlated with both national and military strategy to insure the protection of the precious heritage uppermost in all our minds—the American way of life. Toward this end progress will always be our most important weapon.



Running the Army on a "business basis" may destroy the esprit de corps that is so essential to any good fighting unit.

Has the Army Lost Its Soul?

Maj. George Fielding Eliot

IT'S about time for the people of this country to make up their minds whether they want a reliable fighting army or a uniformed bureaucracy. They cannot have both. The strength of an army—its soul, for that matter—resides in its fighting units.

Much To Learn

The officers and men who compose those units must devote all their time, or almost all of it, to the immensely complicated, difficult, and delicate business of learning how to use their intricate weapons systems, to communicate with each other in the field, to move as fighting teams from place to place under battle conditions, and to survive under the attack of enemy weapons equally formidable.

Anything whatever which detracts from this primary task is an injury to the fighting quality of the army and an affront to the soldierly spirit of its units.

The central objective to which all planning at the highest level should be directed is the production and preservation of these fighting units: the regiments and separate battalions of infantry, artillery, armored troops, and engineers upon whose prideful performance in the hour of peril the safety of the Nation is staked.

Instead, the central objective as of now appears to be the gathering of all the threads of power into the hands of a centralized administration in the Pentagon. Everything is done according to a system devised by bright minds at the seat of authority.

Smaller and smaller grows the scope for initiative, for the exercise of individual responsibility by regimental, battalion, company, and battery commanders, let alone lieutenants.

The company officers in turn, trying desperately in minor ways to impress their individualities on their units, filch from the noncommissioned officers any vestige of authority and prestige the latter might otherwise have. The regimental sergeant major used to be a great man—remember? Today he's just a chief clerk in the adjutant's office (excuse an old soldier—I mean the S-1's office, of course). The first sergeant used to be the captain's right hand and strong arm. Now he's an errand boy for a warrant officer called a "unit administrator" (isn't that a modern hot-shot efficiency title for you?).

Major Eliot is military and naval correspondent with General Features Syndicate and military analyst for the Mutual Broadcasting System. He is the author of several books including "The Ramparts We Watch" and "Hate, Hope, and High Explosives."

Too Much Paper Work

It's all very well to say that without the unit administrator, the company commander would have no time for anything but paper work. Unhappily, he doesn't anyway. There's just too much paper work—and the consequences of neglecting any of it are more immediate and certain than the consequences of neglecting training. Hell hath no fury like the staff officer who doesn't get Form X-4-11-44 right on the dot, to complete his sacred files.

"I tried to train my troops, a job I love," writes an infantry company commander, "and leave the paper to my unit administrator. The first records in-

spection drove me back to my orderly room, from which I emerged only for parades and TIP."

From corporals to colonels, the men whose main job is to train fighting soldiers and forge them into fighting units find themselves instead mere cogs in the vast machinery of the "system"; martyrs to the American devotion to the idea that the American businessman is the most efficient individual in the world and therefore that all American institutions should be "run on business lines."

System Does All

Personnel management, mess management, training, discipline—the system does them all, under the direction of unseen and unknown efficiency experts far off beyond the dim horizon—the gods of the system, to whom daily and hourly obeisance must be made in the form of sheaves of reports in quintuplicate.

The poor soldiers are all bogged down in the resultant mess of paper, over the top of which the harassed unit commander can barely see the men he is supposed to be training and whom he would have to lead in battle if battle were joined tomorrow morning. Everything is checked and double-checked.

"Responsible officers and noncommissioned officers who are expected to lead men in combat," an infantry officer writes, "are treated like delinquent, idiot children."

Something Must Be Done

It's gotten to the point where the attitude is clearly discernible in some quarters of the Pentagon that the combat units exist to be the servants of the administrative system. And don't think the men in the combat units don't get the drift. Something has got to be done about this, or we won't have any combat units worth mentioning, much less worth throwing into battle against a determined and dangerous enemy.

The Army, like the rest of the armed forces, is now settling down for the long pull. For the first time in our history, the Armed Forces Reserve Act gives prospect of building up a real Army Reserve. Indefinite extension of Selective Service seems certain. We are on the threshold of a system of universal service such as has, by stern necessity, been imposed on our European friends these last eighty years or so.

The Army has here a special responsibility to the Nation, for it will get the bulk of the drafted men as long as the option of voluntary enlistment for all three services continues to be maintained. The soldier who does his two years "with the colors" will then have a 6-year Reserve obligation. What is the Army going to do with these young men?

What it does with them now isn't too inspiring. The system takes hold of them from the very outset—the formless, faceless, impersonal system. They are processed, classified, assigned to a training unit—among strangers. They never get to feel any sense of identity or belonging—what's the use? They won't be there long.

Completing their basic training, they go (the combat soldiers) for the most part to Europe or Korea. They travel with strangers. They are assigned to a unit in which they are strangers.

After a while they begin to settle down, to feel that they belong to that outfit—especially if it is a good outfit, with unit pride and competent commanders. Of course the noncoms who receive them and begin molding them into real soldiers are rotated out before they've gotten acquainted; their officers are being constantly changed.

But somehow they do begin to fit—and then their time is up and they're rotated back to the States, assigned somewhere or other (any old where) to fill out their last few weeks, processed again, released from active duty.

But then comes the Reserve tour. Join the National Guard, a home-town outfit? Ha, says the soldier. I've seen those National Guard outfits overseas. When they need 'em, they call 'em into Federal service, tear 'em to pieces, scatter the home-town boys to the four winds of Heaven.

They'd even take the old numbers and colors and traditions away from 'em if they could. Don't give me this "serve with your neighbors" stuff. That's too human for the system. Impersonal. That's their ideal.

But what about the Class A units of the Organized Reserve? There's one that belongs here in town. But wouldn't they get the same deal as the National Guard, only worse because there'd be no State authorities to fight for 'em? Of course. They're not units to the system—they're just collections of manpower to be used as the system may think best.

So it's a fair bet that the bulk of our new Reservists will rock along, being called up for training (with strangers) when they can't get out of it, and longing for the day when they're freed at last of the clutches of a system that hasn't learned how to treat them like soldiers.

Loyal to Country

Loyalty? Of course they're loyal—to their country and all it stands for. But how can they be expected to be loyal to an army that remains just a far-off faceless Something with which they never really come in contact? They know well enough that the men who command them are just the servants of the system. They have no chance to acquire loyalty and pride in any unit, they don't stay with one long enough.

There's an answer to this problem. It's an answer which the British, the French, the Germans have long understood. It's an answer which Alexander found when he created the first truly organized army of history. It's an answer which held the world in fief for Rome.

The answer is simply—don't try to build an army out of men. Weld the men into *teams*—regiments, battalions—and then put those teams together to form your army. Build the spirit of your army not on slogans and TIP

"Units must not be just numbers on a list, to be changed and shifted, abolished, and recreated at the whim of some one behind a desk. They must be imperishable. 'Men die; the Regiment lives.'"

but on the sound basis of team spirit, unit pride.

Your units must not be just numbers on a list, to be changed and shifted, abolished and recreated at the whim of some one behind a desk. They must be imperishable. "Men die; the Regiment lives."

No army in the world has done this as thoroughly—and with as good results—as the British. Just the other day a battalion of the Gloucestershire Regiment fought literally to the last man in Korea. That battalion was the old 28th Foot.

Fought Back to Back

To this day they wear their cap badges front and back to remind them of the day in 1801, on the beach near Alexandria, when they were attacked front and rear by French cavalry. "Rear rank, about face!" cried their colonel —and they fought there back to back till reënforcements came.

At Quatre Bras in 1815 Sir Thomas Picton led them in a charge that broke Ney's lines—"Come on, 28th! Remember Egypt!" Do you think the men who fought in Korea had forgotten these past glories or that they would do anything to dim them?

Every recruit is taught the regimental history—shown the colors and the trophies—when first he joins the depot for training. Every time he has to polish two cap badges instead of one, he remembers why he wears them. Silly? Yes—to a civilian efficiency expert. You'll look a long way for the experienced soldier who'll think it silly.

The "Die-Hards"

Or take the Middlesex Regiment—known throughout the British Army as the Die-Hards. Why? At Albuera, in 1811 (they were then the 57th Foot) they were fighting off three times their numbers of Napoleon's veterans. Colonel Inglis, mortally wounded, cried again and again with his dying breaths: "Die hard, 57th! Die hard!" They did. They went into that fight over 600 strong; they came out with 116 unwounded men.

And in 1917, in the formless mud of a Flanders battlefield, I was leading a combat patrol trying to establish

Army photo

Veteran artillerymen, above, lay down a murderous barrage on enemy positions.

touch with the flank of a British division on our right. Its flank battalion was of the Middlesex Regiment. I came at last upon a lance-corporal and three privates of the Middlesex in a mudhole. The privates were dead, the NCO dying.

But there were some dead Germans scattered in the mud, too, and the flank had held. The lance-corporal lifted himself on one elbow: "We died 'ard, sir," said he with his dying breath—like his long-ago colonel at Albuera.

Same spirit. Bequeathed down the ages. And still putting into soldiers' hearts that last ounce of grim devotion that wins—wins—wins when the slide-rules would say that, by all the percentages, the fight's lost.

Regimental Pride

What does it? Arthur Bryant writes of the fight at Albuera: "The dwindling line continued to close in on its center and still, scarcely more perceptibly than a glacier, to advance on the dazed and astonished French until it was no more than twenty yards away, leaving its dead in rigid lines with every wound in front. *Pride in their regiments and a dogged refusal to admit themselves beaten in the presence of old rivals and comrades kept these stubborn soldiers there.*"

"A Home in the Army"

Recognizing the supreme importance of this unit spirit, this regimental pride, the British Army takes the utmost care to preserve it. When a soldier enlists or is drafted into the British Army, he joins a *regiment*. In that regiment he stays during all his service, active and reserve, unless he himself applies for transfer to another corps. He has "a home in the army," a place *where he belongs*.

From the moment he reports at the depot for training, he begins to learn that his regiment is somehow different from and better than any other. "In The Regiment we do it *this* way"—

nonsense at first, a sacred tradition after it begins to take hold, after he sees that all those about him respect these identifying practices.

His regiment may be very ancient, like the Royal Scots, dating from 1678 in the British service and maybe another 1,000 years of legend. It may be very new, like the Parachute Regiment, only a couple of years of age. But new or old, it is A Regiment, The Regiment, *his* Regiment.

There are a hundred little things constantly to remind him that he is the custodian of undying glories, that he belongs to a military family whose honor is his honor.

Even the military title by which he is called varies from unit to unit—a soldier in a Fusilier regiment is not Private Jones, but Fusilier Jones; he is Rifleman Jones in a Rifle regiment, Guardsman Jones in the Foot Guards, Trooper Jones in the Cavalry (though today he rides a tank), Gunner Jones in the Artillery, Sapper Jones in the Engineers.

Presented to the Colors

He is presented to the colors—the meaning of the battle honors borne on them are explained to him. He learns the regimental motto—and the reason for it.

If he is in, say, the Somerset Light Infantry, he notes that his sergeants wear their sashes over the left shoulder, a privilege reserved in other regiments for officers. Why? Because in a long-ago battle, when the officers were all dead, the sergeants took charge and led on to victory.

If he is in the Rifle Brigade, he hears the command: "Fix swords!" instead of "Fix bayonets!" and learns that in the Peninsular War his regiment had sword bayonets for emergency fighting.

It would never occur to the British War Office that because the 8th Royal Irish Hussars are now equipped with Centurion tanks instead of horses and sabers they should have their honored name changed. Good God, man! They've been the Royal Irish since 1693! They fought under Marlborough! You might as well ask 'em to give up their buff sword belts!

"The idea of a soldier serving out his full period of active and reserve service in just one regiment wouldn't fit 'the finest personnel system in the world.' It might introduce undesirable complications. It might also give men something to live and die for that they can't get from any personnel system. But you couldn't plot a curve to prove it.

"Says Brig. Gen. S. L. A. Marshall: 'While giving lip service to the humanitarian values and while making occasional spectacular and extravagant gestures of sentimentality, those whose task it was to shape personnel policy have tended to deal with manpower as though it were motor lubricants or sacks of potatoes.'"

The French do this sort of thing too. When the French Army was being rebuilt after World War II the oldest regiments with the most honored traditions were chosen as the first to receive modern weapons and become the "covering force" on the frontier.

I remember the colonel of the 93rd Infantry of the Line telling me of a recruit at his first parade being presented to the colors. When the NCO who was explaining the battle honors came to "La Moskowa, 1812" this lad could not contain himself. "Moscow, eh?" he burst out. "Why, if we've been there once we can go there again if we have to!"

And what does the United States Army do about all this sort of thing? Little or nothing. The Marines have the gift of it. They cherish their honored memories and their honored dead. The dying switchboard operator on Midway, who stuck at his post with shattered legs and kept the communication system going amid the falling bombs, said it all when his colonel tried to tell him he'd done well. "Hell, Colonel," said he in some surprise, "we're Marines, ain't we?"

The National Guard tries hard to keep up unit pride and spirit, but when they're called into Federal service the system breaks all that up in a hurry.

The Regular Army has some fine old regiments with traditions as splendid as any that ever graced the British Army List. But the maintenance of those traditions is left to the mercy of the commanding officer for the time being. The system doesn't bother. Why should it? As things stand, nobody stays very long in one outfit anyway.

Wouldn't Fit the System

The idea of a soldier serving out his full period of active and reserve service in just one regiment wouldn't fit "the finest personnel system in the world." It might introduce undesirable complications. It might also give men something to live and die for that they can't get from any personnel system. But you couldn't plot a curve to prove it.

Says Brig. Gen. S. L. A. Marshall in his book, "Men Against Fire": "While giving lip service to the humanitarian values and while making occasional spectacular and extravagant gestures of sentimentality, those whose task it was to shape personnel policy have tended to deal with manpower as though it were motor lubricants or sacks of potatoes. They have destroyed the name and tradition of old and honored regiments with the stroke of a pen, for convenience's sake. They have uprooted names and numbers which had identity with a certain soil and moved them willy-nilly to another soil. They have moved men around as if they were pegs and nothing counted but a specialist classification number. They have become fillers-of-holes rather than architects of the human spirit."

The 3rd Infantry

Take our oldest infantry regiment—the 3rd Infantry. It dates from 1784. It led the van at the storming of Chapultepec. It covered the retreat of the defeated Union Army from the debacle of First Bull Run. "Major Sykes' regulars," wrote the Confederate General Joe Johnston, "made a steady and handsome withdrawal, protecting the rear of the routed forces and enabling many to escape by the Stone Bridge."

The 3rd was the only regular in-

fantry regiment which fought right through the war, from Bull Run to Appomattox, with the Army of the Potomac. It has been known in the Army as "The Old Guard" for more than a century. So what did this fine old regiment do in World Wars I and II?

Nothing. Believe it or not—nothing. It never got into battle.

The last time the 3rd heard a shot fired in combat was in the Philippines in 1906. In the two big wars the system just didn't find a place for it. "Can you imagine," writes one of its former officers, "the British fighting two major wars without using the Grenadier Guards?"

"Deactivated"

Then in 1946 the system proceeded to "deactivate" the 3rd Infantry—The Old Guard. It didn't fit into the Troop Program. This was too much for "Lightning Joe" Collins. When he became Vice Chief of Staff in 1947 he went to work to have the 3rd reactivated, and he got that done in 1948.

But it still didn't fit the sacred Troop Program, so they made it into a ceremonial regiment for the District of Washington, with six understrength rifle companies and one heavy weapons company. It's still there.

What a waste of the very life-essence of armies! But no smug minion of "the finest personnel system in the world" will ever be haled before a Congressional committee and called to account for *that* waste. It can't be measured in dollar signs or added up in the tangled columns of the military budget.

A Lost Battle

It just might, however, be measured in terms of a lost battle one of these days—when beset and battered and bewildered soldiers might not, as the breaking point came close, be sustained by the inner thought; "Hell, we can't break—we're The Old Guard!" That could even be the battle we couldn't afford to lose.

Or take the matter of bands. The finest personnel system in the world got busy on bands some time back. Bands used to belong to regiments. They were part and parcel thereof. Officers used to chip in to buy gaudier trimmings and better instruments for "our band: best damn' band in the Army."

But no more. There's one band in each division (18,000 men) plus a lot of so-called Army bands with numbers neatly attached, stationed around here and there, belonging to no unit. This is tidier and less wasteful of personnel—or is it?

Rudyard Kipling, who knew something about soldiers, writes on this point: "A band . . . revives memories; it quickens associations; it opens and unites the hearts of men more surely than any other appeal. The tunes that it employs and the words that go with them may seem very far removed from heroism or devotion; but the magic and the compelling power are there to make men's souls realize certain truths which their minds might doubt.

Band Interprets Thoughts

"More than that," Kipling goes on, "no one—not even the adjutant—can say for certain where the soul of a battalion lives; but the expression of that soul is most often found in the Band. It stands to reason that a body of twelve hundred men whose lives are pledged to each other's keeping must have some common means of expressing their thoughts and moods to themselves and to their world. The Band can feel their mood and interpret their thought.

Steadying Influence

"A wise and sympathetic bandmaster—and most that I have known have been that—can lift a battalion out of depression, cheer its sickness, and steady and recall it to itself in times of almost unendurable strain. . . . I remember a cholera camp in India, where the men were suffering very badly, when the Band of the 10th Lincolns started a regimental sing-song one night with that queer defiant tune, 'The Lincolnshire Poacher'.

"You know the words. It was merely their Regimental march, which the men had heard a thousand times. There was nothing in it except—except all England—all the East Coast—all the fun and daring and horseplay of young men bucketing about the big pastures by moonlight. But, as it was given, very softly, at that bad time in that terrible camp of death, it was the one thing in the world which could have restored—as it did—shaken men to pride, humour, and self-control."

But—it had to be *their* band to do that. No anonymous Army band with a number and no regimental identity

Men of a 4.2-inch mortar company fire at Communist positions somewhere in Korea.
Army photo

could have filled the bill in that hour of desperate need. They wouldn't have known how, for one thing, and for another they wouldn't have been there. Some bright staff officer would have pointed out that it would be silly to send a band into a cholera camp. Some of 'em might get sick and die. The Lincolns' band was there because it was its duty to be there.

British Keep Bands

Wasteful of personnel to have a band in each regiment—a band that belongs there? The British don't think so. Heaven knows their army has been cut and cut and cut by the economy ax—but they still have a band in every infantry battalion, and in most of the cavalry regiments, too.

I saw the band of the 1st Battalion Royal Warwickshire Regiment in Palestine in 1948—as grimly unpleasant a place, at that time, as a soldier could be in. It was marching off from a formal guard mount, as bright and glittering as though on parade at Aldershot, with the famous regimental antelope mascot led out in front of the drum-major by its traditional escort (the Warwicks won the antelope for their badge in 1710 at the storming of Saragossa when they smashed the French and Spanish cavalry, capturing twenty guns and thirty standards—among them a Moorish flag with an antelope device).

No Bands for Us

But our army can't have regimental bands. The personnel boys don't approve of 'em. Not even though it's been pointed out that the bandsmen can be used as litter-bearers in the field (as they always used to be) so that if you cut the regimental medical company from 208 men to 180 and add 28 bandsmen, you aren't out anything in actual serviceable manpower by any kind of efficiency standards. (To say nothing of what you've added on the spiritual side, for which there are no slide rules.)

I suppose one of the reasons we don't go in for this sort of thing—traditions, regimental identities, bands—is because of a queer feeling that they're somehow foreign and "un-American." Yet American soldiers react to them like any other soldiers.

The late Col. John W. Thomason—himself a Marine, and therefore knowledgable on these matters—tells how two officers of the Texas Brigade protested to President Jefferson Davis:

"They tell us, Suh, in our camp, that the War Department is getting ready to issue an order, to take away our State names—to break us up and mix us around, and to number us by regiments and brigades and divisions like any bunch of conscripts brought in by a posse!

"Mr. President, the Texas Brigade came up here in the summer of 1861.

"I suppose one of the reasons we don't go in for this sort of thing —traditions, regimental identity, bands—is because of a queer feeling that they're somehow foreign and 'un-American'. Yet American soldiers react to them like any other soldiers. . . . We have been learning and unlearning this lesson for 180 years. We can apply it now, as we set our hands to the great task of establishing a permanent system of military service."

Right after Manassas. We popped our first caps at Ethan's Landing. We was the boys that broke the line at Gaines's Mill. Second Manassas, Mr. President!" (The windows rattled and the lamps flickered.) "Sharpsburg—you slick civilian, there, did you ever hear tell of the cornfield at Sharpsburg? Fredericksburg! Gettysburg! Chickamauga! The Wilderness! An' Spottsylvania. Cold Harbor! . . .

"We have our battle flags that our women gave us, Mr. President. They are Texas flags. Texas ladies made them. Texas boys fought under them. Those names I named you, they are on those flags. Will you take 'em away from us, an' give us a number in place of them? And a number in place of our Texas name?

"Mr. President, we Texans have obeyed orders. We aim to keep on fighting while the war lasts. But, Mr. President, we are the Texas Brigade, an' so we will remain—."

That's the whole story in a nutshell. We have been learning and unlearning this lesson for 180 years. We can apply it now, as we set our hands to the great task of establishing a permanent system of military service for the protection of this Nation in troubled times. We can build our regiments—permanent, indestructible regiments—based on the traditions of a glorious past, drawing upon the spirits of the men who suffered at Valley Forge, who stormed the British guns at Lundy's Lane, who planted the scaling ladders against the walls of Chapultepec, who fought through the long years of 1861-1865, and of World Wars I and II—and those who have added new luster to their arms in Korea.

Can Build an Army

Having reclaimed these traditions and built our regiments, we can then build from them an army in which every combat soldier will have a sense of belonging—a loyalty that he can feel and understand.

He can train, not in some faceless training division, but at the depot of his own regiment. He can go overseas to join it—not as an item in a package of groceries tied up with a string, but as a draft of The Regiment, going to join his own. When he's rotated, the regiment rotates. When he goes to the reserve, he is a reserve soldier of his regiment. If he's called back, he rejoins it. When he takes his annual training tour, he trains with it.

Sure, there'd be difficulties. You'd have to recruit your regiments from a single defined area, for one thing, and station the regimental depot in that area. You'd have some transfers, because of men moving to other areas. It could get complicated.

Not for Bread Alone

As one officer writes, "Anything human would be bound to be. But it would retain that precious feeling of mutual confidence that makes men fight. It would make the combat arms feel that the Army considered them important, and worth some trouble. . . . Men, and especially soldiers, don't live or die for bread alone."

Maybe it's just "the army of a dream" that I'm writing about. But I wish we had an Army like that.

The Joint Chiefs of Staff

In May the President named completely new personnel to the Joint Chiefs of Staff. Adm. Arthur W. Radford, who has been Commander in Chief of the U. S. Forces in the Pacific, is to be Chairman of the Joint Chiefs. Gen. Matthew B. Ridgway, Supreme Commander of the North Atlantic Treaty Forces in Europe will become Chief of Staff of the Army; Gen. Nathan F. Twining, formerly Vice Chief of Staff of the Air Force, has been made its Chief of Staff; and Adm. Robert B. Carney, Commander in Chief of NATO forces in Southern Europe, will become Chief of Naval Operations.

Adm. Arthur W. Radford
Chairman, Joint Chiefs of Staff

Gen. Matthew B. Ridgway
Chief of Staff of the Army

Gen. Nathan F. Twining
Chief of Staff of the Air Force

Adm. Robert B. Carney
Chief of Naval Operations

Reserve Ordnance Production Capacity

An Essential Part of the National Defense of the United States

On March 4, 1953, the Board of Directors of the American Ordnance Association appointed a committee to formulate a policy on reserve ordnance production capacity. Under the chairmanship of Adm. W. H. P. Blandy, U.S.N. (Retired), the committee completed its report, it was approved by the Board of Directors, and was presented to the Secretary of Defense on May 1, 1953, by Lieut. Gen. Levin H. Campbell, Jr., Association president. The complete report is published below for study by all A.O.A. members.

THIS committee was appointed by the Board of Directors of the American Ordnance Association on March 4, 1953, to present a policy for adoption by the Board on reserve ordnance production capacity. The committee consists of the following members of the Association:

Adm. W. H. P. Blandy, U.S.N. (Retired), Health Information Foundation, New York, *Chairman;*

Rodger J. Emmert, General Motors Corporation, Detroit;

Howard E. Isham, United States Steel Corporation, New York;

W. G. Lockwood, American Locomotive Company, Washington;

K. T. Norris, Norris-Thermador Corporation, Los Angeles.

General Considerations

The committee, mindful that the American Ordnance Association comprises more than 33,000 American citizens, many of whom are executives and engineers of American industry presently engaged in various phases of the armament production program, urges that the Association petition the Department of Defense of the United States to adopt the following national policy on reserve ordnance production capacity without delay.

Such policy should be directed to the maintenance, extension, and continuing modernization of plant and equipment in stand-by condition for the production of ordnance end items over and above current needs to provide for full mobilization rate requirements.

The preservation of the national asset which our country has built for ordnance production—Army, Navy, and Air—must be a vital part of our defense program throughout the foreseeable future.

In the adoption and promulgation of such a national policy time is of the essence.

First in the preparation of such a policy is the determination of over-all needs for military end items. Hence, a comprehensive and authentic statement of end-item ordnance requirements both for current procurement and for full mobilization (emergency), revised periodically, for our Army, Navy, and Air Force should be compiled on behalf of the Department of Defense without delay.

The determination of these requirements is a governmental function. Such schedule for full mobilization requirements must be realistic and within the capacity of the country to produce.

Furthermore, where there are deficiencies in manufacturing equipment, machine tools, etc., these deficiencies must be met currently so that such additional production facilities as may be needed under conditions of maximum utilization to meet end-item requirements are available as quickly as possible.

In the atomic age, more than ever before, reserve stocks of ordnance when added to immediately available end-item production capacity must always be sufficient to meet the military requirements as defined above.

Specific Recommendations

The committee recommends that: The American Ordnance Association urge that required ordnance reserve production facilities be preserved to meet full mobilization-rate requirements and that they be maintained in an up-to-date condition ready for rapid activation in case of emergency. Specifically, that the Association recommend:

(a) With respect to present production facilities where plant and production-line equipment are owned by the United States Government and are being operated by private organizations, that such reserve facilities be placed in stand-by in their present location under the care and surveillance of the private producer and that contracts for this purpose be entered into forthwith.

(b) With respect to reserve production facilities where plant is owned by a private producer and the production-line equipment is the property of the United States Government, that contracts be entered into immediately with the present producer for the location and surveillance of such equipment within or adjacent to the present plant. If additional structures are required for the location and pilot-line operation of such equipment on or adjacent to their present location, such structures should be built without delay. Periodic production orders for the operation of the equipment from time to time should be made a part of such contracts where possible.

(c) With respect to special miscellaneous Government-owned machine tools now in the hands of manufacturers of components and which do not constitute complete production lines, that these should *(Continued on p. 46)*

PLANT AND PRODUCTION LINE EQUIPMENT GOVERNMENT OWNED
PRIVATELY OPERATED
GOVERNMENT OWNED MACHINE TOOLS
USED BY PRIVATE MANUFACTURERS FOR MISCELLANEOUS PURPOSES
To be placed in stand-by in their present location under the supervision of private producer.
Be classified as a National Machine Tool Reserve and preferably remain in use by manufacturer.
RECOMMENDATIONS
OF THE BLANDY COMMITTEE
"That the American Ordnance Association urge that required ordnance reserve production facilities be preserved to meet full mobilization-rate requirements and that they be maintained in an up-to-date condition ready for rapid activation in case of emergency." The specific means for accomplishing these objectives are illustrated here.
To be placed in stand-by within or adjacent to the present plant in special structures if necessary.
Engineering improvements of standard weapons and limited production by private industry.
PRODUCTION LINE EQUIPMENT GOVERNMENT OWNED
RESERVE
PLANT OWNED PRIVATELY
USING SERVICES CAN TEST AND EVALUATE
BETTER WEAPONS FASTER
CONTINUAL EMPLOYMENT OF ENGINEERING PERSONNEL

Adm. W. H. P. Blandy | Rodger J. Emmert | Howard E. Isham | W. G. Lockwood | K. T. Norris

be classified as a national machine-tool reserve. They should preferably remain under the jurisdiction of the manufacturer in order that production know-how as to items not regularly produced commercially may be maintained at a maximum. Such arrangements should not preclude the use of the facilities by the producer for commercial work on a basis equitable both to the Government and the producer. Both the knowledge and the equipment of these suppliers are tremendously important.

(d) The improvement and development of weapons are a vital part of this program. Therefore, contracts for the engineering improvement of standard weapons should be entered into with private industry for the continual employment of its engineering personnel on the problem.

(e) Periodic educational orders for limited production of important key items should become an established part of our national armament policy in order to develop more effective weapons, reduce the time required to attain initial production in case of an emergency, and to enable the using services to test and evaluate such new items in Army, Navy, and Air Force maneuvers.

(f) Reserve production capacity of the most modern design is indispensable. Such capacity must consist of the very latest types of machine tools and in adequate quantity.

Since the development of processes of manufacture, machinery, special tools and equipment for the specific end item is a very desirable part of this policy, the cost of the development of better methods, machinery, tools, and equipment should be regularly established as a specific item in fiscal budgets.

(g) Finally, the above program should be adopted as a continuing national policy, and the Department of Defense should be empowered to enter into long-term contracts with commercial producers with proper cancellation clauses and renewal privileges sufficient to carry out this policy.

In submitting the above proposals the committee is mindful of our national experience following the First and Second World Wars and the cost in American lives and money which have ensued by reason of the lack of a continuing policy with respect to ordnance reserve production capacity to meet emergency requirements. In arriving at these conclusions the committee has been aided by the following texts which are of essential importance in the field of national industrial preparedness:

(1) "Blueprint for Preparedness," by Charles Erwin Wilson, president, General Motors Corporation. This was an address on dual-purpose plants delivered to the members of the American Ordnance Association at Cincinnati, Ohio, October 4, 1951 (ORDNANCE magazine, January-February 1952 issue, Volume XXXVI, page 594).

(2) "Production Capacity—A Military Reserve"—a report to the Director of Defense Mobilization by the Advisory Committee on Production Equipment, Harold S. Vance, Chairman (U. S. Government Printing Office, January 1953).

(3) "Reserve Production Facilities for Military End Items"—an address by Rodger J. Emmert before the Industrial College of the Armed Forces, February 5, 1953 (ORDNANCE magazine, May-June 1953 issue, Volume XXXVII, page 929).

Respectfully submitted,

(*Signed*) W. H. P. BLANDY, *Chairman*

RODGER J. EMMERT W. G. LOCKWOOD

HOWARD E. ISHAM K. T. NORRIS

THE SECRETARY OF DEFENSE
Washington

May 28, 1953

Dear General Campbell:

I want to take this opportunity to thank you and the members of the special committee of the American Ordnance Association under the chairmanship of Adm. W. H. P. Blandy, U.S.N. (Retired), for the excellent report which they have made in regard to "Reserve Ordnance Production Capacity."

I have read this report with considerable interest and am sure that we in the Department of Defense will find the recommendations of the committee extremely helpful. I am anxious to take steps as soon as possible to see that these recommendations are integrated into our mobilization policies.

As I asked you over the telephone today, I hope that you can send me additional copies of this report in order that we can give it the widest circulation throughout the Department of Defense. I appreciate your assurance that the American Ordnance Association stands ready to be of assistance in this undertaking, as in others, and assure you that we will not hesitate to call upon you for your assistance and advice.

With kindest regards.

Sincerely,

(*Signed*) C. E. WILSON.

Lt. Gen. Levin H. Campbell, Jr.,
President,
American Ordnance Association,
Washington 6, D. C.

The Ammunition Problem

Ordnance Procurement and Production Responsibilities

Maj. Gen. E. L. Ford

Chief of Ordnance, United States Army

AS Chief of Ordnance I have always felt that of my various responsibilities none is more important than the very crucial field of ammunition in which this subcommittee is particularly interested at this time.

Went into Action

Within a few hours after the outbreak in Korea, Army Ordnance, as part of the Army team, went into action. To illustrate to this committee the tremendous impact of that unforeseen event, here are a few examples of the actions taken by Ordnance with respect to ammunition and the results achieved by Ordnance acting in concert with American industry, in the first six months after that outbreak:

1. Nearly 350,000 tons of ammunition (over ninety per cent of which was artillery ammunition) were shipped from stocks to Korea to augment supplies in the theater.

2. Renovation of ammunition stocks on hand was expedited in eighteen plants and pushed to the limit to help fill the production lead-time gap.

3. The Ordnance Ammunition Center was established as the field command headquarters to direct Ordnance ammunition production; at the same time initial orders were placed rapidly with industry for new production of ammunition and components.

4. Action was initiated to put into operation seventeen powder, explosive, loading, and assembly plants for the production of new ammunition.

5. Authority to take quick and decisive action was delegated to field commands to the extent delegated to me, together with instructions necessary to guide and control field actions.

6. Eight thousand civil-service personnel were recruited and trained as the first increment to handle the rapidly expanding procurement, renovation, and manufacture of ammunition.

These actions included some of the essential steps preceding the procurement and production of ammunition. In discharging the responsibility for procurement and production, I must act in accordance with law and regulations and within the limitations of the authority delegated to me.

To acquaint this subcommittee with what has been achieved by Ordnance and industry in the procurement and production of ammunition I will attempt to present some of the more important problems encountered and the actions taken to resolve them.

The Broad Aspects

First, however, I would like to review the broad aspects of ammunition procurement and production within the scope of my authority and responsibility. This is a complex subject. The field was covered in a general way in a statement made to the full committee on March 10, 1953, by Colonel Medaris of my office.

At this time I will not attempt to cover minutely many aspects that involve extensive detail. Should you care to explore any particular phase more in detail, the necessary information will be made available to the committee.

The Army Ordnance organization involved in the task of ammunition procurement and production includes:

1. A substantial segment of my Washington office, which manages the program;
2. An ammunition field headquarters, called the Ordnance Ammunition Center, at Joliet, Ill., which is charged with the responsibility for the major portion of the procurement of ammunition components and the reassembly into finished ammunition;
3. A Small Arms Ammunition Center at St. Louis, Mo., which handles that part of procurement involving small-caliber ammunition;
4. Fourteen Ordnance procurement districts in key industrial centers of the United States; and
5. Two arsenals, one at Dover, N. J., known as the Picatinny Arsenal, and one in Philadelphia, known as the Frankford Arsenal. These two arsenals are the peacetime custodians of engineering "know how" in ammunition production and during times such as the present furnish technical advice and assistance throughout the ammunition production area.

Small Staff in 1950

In 1950, at the beginning of Korea, the ammunition procurement organization of the Ordnance Ammunition Center and the Ordnance procurement districts was staffed with approximately 21 military personnel and 263 civil-service employees.

Today there are 127 military personnel and 6,200 civil-service employees in those same organizations devoted to that activity. This build-up was accomplished during a period of peak employment in this country.

The Ordnance method of ammunition procurement was developed before

This statement was delivered by General Ford before the Senate Subcommittee on Ammunition Shortages and is published here in full so that the members of the American Ordnance Association may have a more complete picture of the important subject of ammunition manufacture and supply.—THE EDITORS.

World War II and after careful examination was officially approved on July 23, 1940, by Mr. Henry L. Stimson, then Secretary of War. With minor refinements it proved effective throughout the war period.

Our system of operation of Government-owned, contractor-operated powder, explosive, loading, and assembly plants was commented upon most favorably in 1944 by the Hon. Albert J. Engel, who was a one-man investigating committee for the Appropriations Committee of the House of Representatives.

In general, our ammunition-procurement system provides for the manufacture of powder and explosives in Government-owned plants operated by contract with industry; distribution throughout the appropriate type of American industry of direct contracts for the manufacture of all nonhazardous components; and the final assembly into finished ammuntion in Government-owned loading and assembly plants, most of which are also operated by private industrial companies under contracts with Army Ordnance.

Since we use the term often, I would like to explain that our loading plants perform the hazardous tasks of assembling the explosives and propellent powders into the various ammunition components and assembling these various parts into a finished round of ammunition.

Best Advice Sought

In all our Ordnance operations we have always been conscious of the importance of seeking the best civilian advice and criticism to keep our ways of doing our work efficient and up to date.

To this end our organization and plan of procurement were examined at my invitation on August 16, 1950, by a group of distinguished industrialists, including the Hon. Bernard Baruch; Benjamin Fairless, president of United States Steel Corporation; C. H. Greenewalt, president of Du Pont; K. T. Keller, president of Chrysler Corporation; Charles E. Wilson, president of General Electric Company; and John Slezak, president of Turner Brass Works.

Again in August 1952, at my invitation the Ordnance Advisory Committee, which has been of great assistance, reviewed my organization and system for procurement and production. This Advisory Committee consists of: Harvey C. Knowles, vice-president of Procter & Gamble Company; Ernest W. Pittman, former president of Interchemical Corporation; C. Jared Ingersoll, chairman of the board of the Kansas, Oklahoma, & Gulf Railway Company; Martin H. Eisemhart, chairman of the board of Bausch & Lomb Optical Company; and Stanley C. Hope, president of Esso Standard Oil Company.

On various occasions during this critical period, particularly in the spring of 1951 and in January of 1952, we met with a group of advisers whom we call our Purchase Policy Council. This council, in addition to the principal members of my own staff, includes: Irving A. Duffy, vice-president, Ford Motor Company; E. T. Gushée, vice-president, Detroit Edison Company; Robert Downie, president, Peoples First National Bank & Trust Company, Pittsburgh; and other important members of the financial and industrial community.

The District Chiefs

In addition to those whom I have mentioned specifically, Ordnance has a very important group of advisers by reason of having outstanding citizens serving as civilian chiefs of eleven of my district offices. Most of these civilian district chiefs also have advisory boards composed of outstanding citizens of the community.

With these various groups of advisers, Ordnance has explored many of the problems of ammunition procurement and production, including our organization and methods. We have received from these groups valuable suggestions and assistance, and as a result some important improvements in our procurement have been made. In general, I have had confirmed in my mind the soundness of our organization and the efficiency of our methods.

To acquaint you with the extent to which we avail ourselves of the knowledge and experience of many people, I am making available to the subcommittee a full list of these outstanding and patriotic citizens.

The process leading up to the procurement of ammunition begins with operations plans prepared by the Army General Staff. The process, guide lines, computations, and reviews required to translate these operational plans into requirements for troop use and reserves, thence to the preparation of a budget for presentation to the Congress, will be explained to this committee by other witnesses.

Higher Authority

I desire at this time to make it clear that Ordnance is responsible for furnishing cost estimates and for the computation of quantities of items strictly in accordance with the plans and guide lines established by higher authority.

After the Congress passes an appropriation act and funds are made available to the Army, it is then legally possible to enter into contractual procedures involving the expenditure of these funds. This does not mean, however, that Ordnance is free to obligate these funds.

At the time the money actually becomes available to the Army, and in accordance with established guide lines, a detailed listing is prepared covering those specific items and types of ammunition to be procured.

Only upon approval by higher authority of such a specific list for procurement is the money made available to Ordnance authorized for obligation and expenditure. These specific lists are known as "approved programs."

I believe that it is equally important to understand that all the money approved for the procurement of ammunition in any fiscal year does not come to Ordnance at one time. Throughout the fiscal year additions to the program are continually being passed to Ordnance, each of which requires new procurement actions. These additional monies and programs come from several sources:

1. In recent years there has been a considerable amount of money placed in ammunition production for military assistance to foreign countries.

2. Army Ordnance produces many items of ammunition for the Navy, Marine Corps, and the Air Force—orders for the procurement of which come from those services at various times throughout the year.

3. On several occasions the Army has

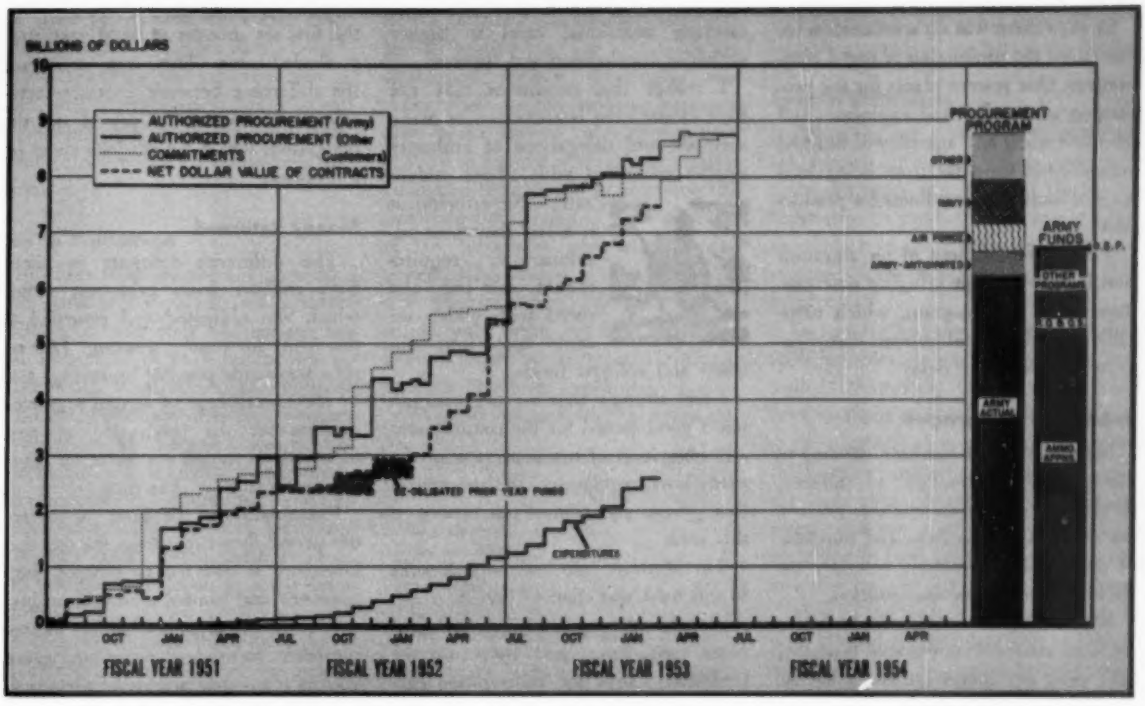


Chart A. Status of the Ordnance Corps ammunition program for the Army and all customers as of March 30, 1953.

reprogrammed to ammunition procurement, funds originally allocated to other items.

4. In addition, money resulting from savings is constantly fed back into the ammunition program. Since the start of volume procurement we have been able to lower steadily the actual cost of most ammunition.

For example, the cost of ammunition per ton in 1951 was $1,526; in 1952 this was reduced to $1,308; and so far in 1953 is down to approximately $1,272 per ton.

Savings effected by these lowered costs are reported to the Army for reprogramming, and approval is requested for the purchase of additional quantities of the most needed types of ammunition.

Additional Funds

5. An additional source of funds for the ammunition program is by reimbursement for transfers from stock. The money representing the value of these transfers goes to the credit of the Army and may be used for additional procurement when so approved by higher authority and transmitted to Ordnance.

Upon receipt of authority and money to procure a specific quantity of ammunition, my organization starts the actual procurement job. Whenever we are reasonably certain of the items and quantities that will be approved, I direct my organization to begin initial procurement action before actual approval and money is received.

Ordnance Alert

The degree to which Ordnance has moved rapidly—and frequently well in advance of the receipt of funds—to transmit procurement actions to the Ordnance Ammunition Center and the arsenals will be made evident to you in a moment.

My field headquarters must at this point perform the most important operation of computing, against the quantities of finished ammunition items to be manufactured, the quantity of each component to be placed under contract with industry and the required schedule of delivery.

This grouping and scheduling operation is essential to provide flexibility in production and economy in procurement. Schedules of requirements for ammunition components having been prepared, the actual job of placing these requirements under contract with industry is launched.

The locating of suitable, qualified manufacturers to produce the hundreds of different components in the ammunition program, the negotiation of contracts with those manufacturers, and the acceptance of full responsibility for the legality and correctness of the procurement process is part of the important work that I have assigned to the Ordnance procurement districts.

To give the committee some idea of the magnitude and complexity of this task, I should like to make available to the committee a set of regulations which control our contracting activities and the relations between our contracting officers and the producers of our ammunition.

Firm Agreement Needed

Only when a firm agreement has been made, binding both the Government and the contractor, does Ordnance consider the money legally obligated. The complexity of Government contracts and the substantial amounts of money involved cause both parties to exercise great care before an agreement can be finally concluded. . . .

In 1950 there was no ammunition industry for the production of metal components. Our reserve plants for the production of powder and explosives and for the loading and assembly of finished ammunition were far from being in a state of immediate readiness for production.

The reëstablishment of an ammunition industry meant bringing new producers into the program, which naturally introduced additional complications and factors of delay.

Expansion Encouraged

Maximum effort has been devoted to encouraging contractors to finance, through private or commercial sources, the expansion of facilities and purchase of production equipment necessary for the manufacturer of ammunition.

Since ammunition components are in no sense standard commercial products, and since no contractor could be assured that the ammunition production program would continue for any considerable time, it has in most cases been necessary to supply Government-furnished equipment to contractors.

To date we have invested approximately $900 million in facilities and production equipment for the manufacture of ammunition. Of this amount, $667 million has been committed to the reactivation, rehabilitation, and equipping of Government-owned plants, while the balance is invested in facilities and equipment for use by private industry in the manufacture of metal components for ammunition.

The majority of these expansions were financed from funds known as "expediting production," controlled by the Under Secretary of the Army and made available to Ordnance only after submission of project requests for approval by the Under Secretary.

Authority Delegated

During this important period when our ability to select contractors and bring in new producers with rapidity was of primary importance, I delegated to my field commands every authority which I was permitted to delegate. In spite of this, we encountered many contracting delays of an administrative nature that were resolved only after carrying individual cases to higher authority for decision and approval.

I realize that conditions may not have favored the introduction of many methods and delegations of authority usually associated with all-out mobilization. Nevertheless, it is a fact that these administrative requirements limited the speed with which we could enter into contracts and obligate funds.

I feel strongly that my organization has a good record for the commitment and obligation of funds in view of the many laws, regulations, and procedures that govern and control our actions in this area.

To illustrate our accomplishments in this field, this chart [Chart A, p. 49] shows the flow of funds for the fiscal years 1951, 1952, and 1953 into the Ordnance Corps for ammunition procurement and into contracts for the production of ammunition. The chart shows all the money available to Ordnance for authorized procurement of ammunition received from any source during this period.

The chart indicates clearly that orders are received in increments of varying size throughout the year. Each step upward represents additional orders. Each drop downward indicates the withdrawal of money or orders from the system.

You will note that during fiscal years 1951 and 1952, Ordnance committed orders to field agencies generally well in advance of full authorization for procurement from higher authority.

"For many months after the outbreak in Korea there was no priority system for regulating the delivery of metalworking machine tools. Our contractors, after receiving optimistic promises of delivery from machine-tool builders, encountered one setback after another on the order boards."

The heavy broken black line on the chart shows the net dollars placed on contracts for the production of ammunition. You will note on the chart during the first six months of fiscal year 1952 a shaded area. This area represents the difference between contracts actually placed during this period and the obligations which we officially show on our books.

Money Returned

The difference amounts to about $350 million from prior-year funds which was obligated and returned to the Army for reprogramming. This return was made possible by savings and by the cancellation of certain approved projects for the production of new items which turned out to be not ready for production at that time.

Examination of the chart for the entire period shows that from the day that Ordnance is directed to proceed with approved and funded ammunition procurement, my organization has located competent contractors, negotiated terms, and awarded contracts in an average of 113 days.

The summary analysis sheet [not published here—Ed.] supporting this chart shows in detail the flow of funds into and within the ammunition procurement system since the beginning of Korea.

Production Lead Time

I now would like to discuss production lead time, a most important subject and one in which I know this committee has great interest. I want to emphasize that production lead time begins with the award of the contract to industry and not before.

In carrying out its ammunition-production job, industry encountered many difficulties and many problems. The Army Ordnance organization maintained constant contact in order to lend to any contractor all the assistance that could properly be given to him in complying with his contract.

The major job, however, was in the hands of our contractors, aided by the national agencies established to control the Nation's resources. I would like to tell you about some of the problems experienced by our contractors in getting into production.

In the early stages of the ammunition program, and particularly during early 1951, we and our contractors felt that

we were faced with an all-out emergency and that we would have available all the resources and priorities that go with such an emergency. Based on this impression, we and our contractors greatly underestimated production lead time.

Key to Production

Machine tools are the key to getting into production. The machine-tool builders in early 1951 had not felt the full impact of defense production requirements. Contractors, accepting as valid the optimistic delivery promises given them by the machine-tool producers, and also believing that immediate emergency procedures and priorities would be available to them, estimated that they could install these facilities and get into production in a few brief months.

Ordnance, likewise thinking in terms of emergency action and overriding priorities, accepted the contractor's estimated schedules.

Conditions did not develop as anticipated. Machine-tool deliveries were badly delayed. Contractors encountered all the obstacles that are inherent in attempting to expand rapidly in an economy already operating at a very high level. As a result, new producers required almost twice as long to get into production as they had anticipated.

Even after first production began, machine-tool and material problems impeded rapid acceleration to full production. The difference between the original estimates and actual achievements has come to be known as "slippage."

Production Rescheduled

During that early period we were loath to accept the full impact of conditions as they developed. We rescheduled production more than once, each time reflecting the difficulties encountered, but still with a certain unwillingness to accept the fact that conditions would not improve. We knew our contractors were doing their best, and we had confidence in them.

Our last general rescheduling took place right after the steel strike of last summer. By that time sufficient experience had been gained to warrant a new approach to the all-important problem of scheduling, and as a result we established average production lead times which we felt could be improved only under exceptional circumstances.

We had learned that without a major change in the conditions governing this preproduction period, a new producer of an important ammunition component, who needed to acquire and install substantial production equipment, would only begin his first small production about twelve months after the contract had been confirmed.

We also learned that a contractor must be provided with an additional or continuation order at least four months before he finishes production of his current orders in order to plan and secure essential materials and keep a trained work force.

After production of the shell or cartridge case by the contractor, we still need two months for the cycle of shipment, loading, assembly, and acceptance testing before the finished ammunition is produced.

It is clear to us therefore, that continuation orders must be placed with our metal-parts producers at least six months before we produce the last of our previously scheduled quantities of complete rounds of loaded ammunition.

March 25, 1953

Major General E. L. Ford
Chief of Ordnance
Department of the Army
Washington 25, D. C.

Dear Sir:

We are submitting herewith a chart indicating activation and production lead times for the production of heavy artillery ammunition.

It is our opinion that the lead time as shown on this chart, namely, a requirement of twelve months from the signing of a contract to the production of a pilot lot and a period of eighteen months from the signing of a contract to full one-shift production, represents normal average requirements for this type of industry.

It is probably true that under certain unusual conditions this period might be somewhat compressed, but such a reduction of time required would, in our opinion, be the exception rather than the rule.

We base the above opinions not only upon our knowledge of time requirements necessary to activate many types of industrial operations but also upon the results of our concurrent survey of ammunition-component manufacturers.

Respectfully yours,
MEAD-CARNEY & COMPANY, INC.
COLWELL J. CARNEY, *president*

Special Difficulties

Returning for a moment to some of the special difficulties which hindered our contractors and impeded the rapid beginning of production, I would like to mention in more detail the need for machine tools and production equipment.

In 1950 we had some reserve machine tools in storage, other than those installed in stand-by plants, which had been retained after World War II. Due to the disposal regulations in effect after the last war, and other actions affecting the tools which could be retained, this reserve did not in any case leave a complete line of tools for the production of any one item of artillery ammunition.

Most of the tools in reserve had hard wear during the last war and required extensive rebuilding before being put in service. As a result, although we were able to ease the strain on the machine-tool industry by making these tools available to our contractors, production could still not begin until the gaps were filled and new tools secured to complete the line.

In addition to the difficulties affecting the procurement of all machine tools, important types of heavy tools, such as the large presses used in cartridge-case lines, require a minimum of ten months to build, thus emphasizing in still another way the lead time required by ammunition producers.

For many months after the outbreak in Korea there was no priority system for regulating the delivery of metal-working machine tools. Our contractors, after receiving optimistic promises of delivery from machine-tool builders, encountered one setback after another on the order boards.

Confusion Scored

As late as June 1951 the machine-tool industry was still complaining vehemently about the confusion regarding price ceilings, lack of priorities for materials, financing difficulties, and manpower troubles. It was not until July 9, 1951, that the first directed priority actions were applied to machine tools.

Also during this period, ammunition

did not enjoy a special priority position over other defense matériel. In fact, it was not until December 1951 that any portion of the ammunition program received special priority recognition outside of the Army. At that time, seven types of artillery ammunition were placed in a special emergency category.

Similar although less controlling difficulties were encountered in securing adequate quantities of the special materials required for the manufacture of ammunition. An effective controlled-materials plan was not in operation until July 1951 and did not operate to assure all needed materials for ammunition until some time after that. The different types of steel and other metals required for the ammunition program, and the scheduling of our requirements by NPA, dislocated the normal channels used by our contractors for securing materials and created many situations requiring emergency action.

Our contractors had no more than glimpsed a solution to these material problems when they were hit by the steel strike, which naturally disrupted all normal supply channels. Ordnance stepped in and transferred steel to producers of the most critical items.

I could add many details, but to save the time of the committee I am making available an amplified analysis of the machine-tool and material problems for your further consideration.

I am emphasizing the machine-tool problem because tools create the major problem in setting up new facilities and getting production started and because the difficulties encountered by our contractors in that field were the major impediment to earlier production from initial orders.

Not End of Story

So far I have discussed lead time only as applied to the contractors producing important metal components of ammunition such as projectiles, cartridge cases, and fuzes. The production of a finished empty shell is not, however, the end of the story. There is still much to do before we have a round of finished ammunition.

However, before leaving the field of metal-component manufacture I should like to present a chart to illustrate the lead-time period in detail as it applied to producers of the type of components which I have mentioned.

This chart [Chart B, p. 53] was not prepared by my organization, but by Mead-Carney & Company of New York City—a group of recognized industrial engineering specialists. It presents their findings as to the fundamental and inescapable elements that governed the production lead time encountered by new producers in setting up their plants to produce these more important metal components.

This chart illustrates . . . on a time scale the various actions and preparations required to set up a plant for volume production of a reasonably difficult metal component of ammunition, such as the empty projectile for medium and heavy artillery.

Every Effort Made

There are many things to be done, as you see. Every effort was made to carry on these varied actions simultaneously, but this is not always possible. For example, the installation of a machine tool must wait until the tool is received.

Not all equipment arrives at once, but our contractors did not wait for everything before first attempts at production. As soon as the plant received one of each type of equipment required, the manufacturer turned out a small trial quantity, known as a pilot lot.

These first lots from new producers must be thoroughly inspected and tested, for errors left to stand at this point will cause the production of bad shell or cases—wasted time and money. Often the first small lot was almost but not quite up to the exacting standards for safe and efficient ammunition, and changes and adjustment in tooling were required before the production line could be started up in earnest. The first regular production lot is watched most carefully. If it is good, it means that tools and methods are satisfactory and the contractor can begin to reach for volume production.

At this point the contractor was still a long way from being able to turn out the full expected capacity of the line. Machines and equipment were still coming in, being installed, tooled, and tested. More workers had to be hired and trained to efficient performance.

18-Month Average

Finally, on an average of eighteen months after the award, he was able to produce the expected quantity from a single shift and was on his way toward capacity output.

Along with this chart I would like to read into the record this letter from the Mead-Carney Company [see p. 51], stating clearly their professional opinion with respect to lead time for ammunition production during this emergency.

These facts support and confirm our own conclusions. There were exceptions to the average periods shown, and improvement is always possible for a few plants if brought along under the highest priority.

However, the 12- to 18-month period for establishing production at a substantial rate has held good for the most important and highest dollar-value metal components of ammunition.

Returning now to the fact that the production of the projectile does not mean finished ammunition, I would like to bring out some of the special factors in the production of safe, efficient ammunition that control our procedures from this point on.

Ammunition is a death-dealing commodity. Our first responsibility is to the American soldier. We must be absolutely sure that ammunition is safe to handle, safe to ship, move, and even to drop accidentally; that it will still be safe and dependable after long exposure to wind and rain, heat or cold, and yet be certain that it will function surely and effectively at the precise instant the soldier wants it to.

That is a big responsibility. To be absolutely certain, we cannot overlook any of the many operations that go into the making of the final product.

Every component must be rigidly inspected during and after manufacture and finally tested the hard way—by actually firing samples selected at regular intervals and assembled with stand-

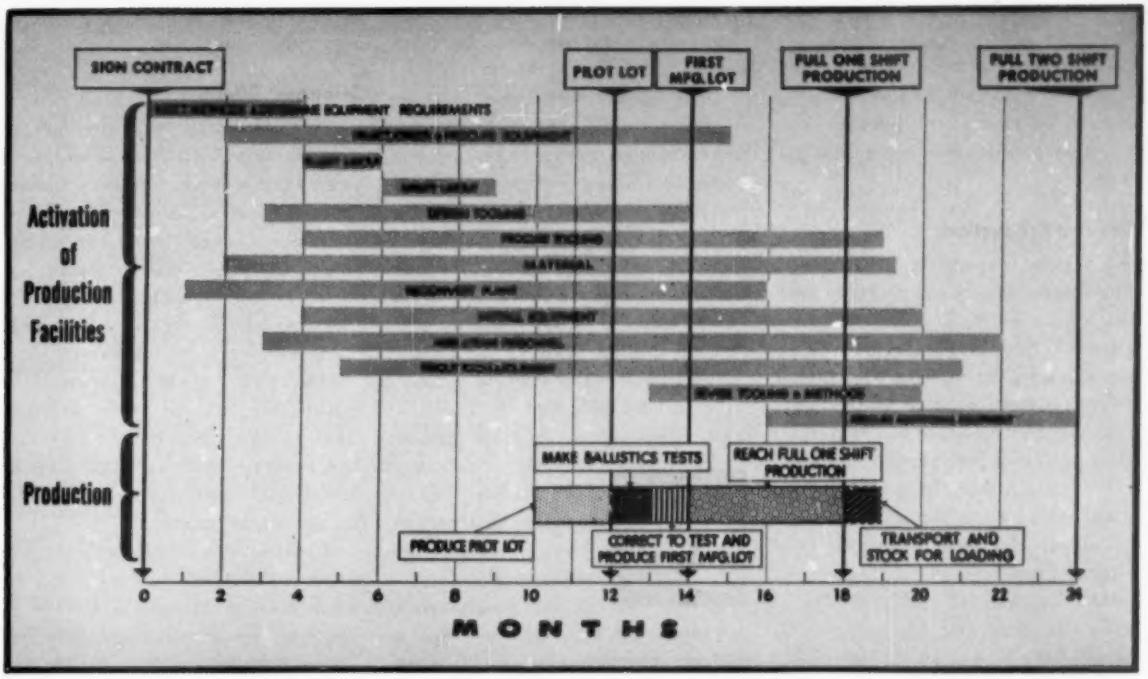


Chart B. Activation and production lead time for heavy metal components.

ard components previously tested and selected for the purpose.

Samples Tested

Samples of cartridge cases and projectiles taken at the contractor's plant are shipped to our proving grounds and tested by actual firings. Satisfactory tests of these samples permit shipment of the manufacturer's lot to the loading and assembly plants.

At each step of the loading and assembly process certain samples must be test-fired. That means test-firing each lot of loaded fuzes, boosters, and primers. Each lot of powder must be carefully tested in order to establish the exact quantity needed to secure the precise standard velocity and thus the accuracy required to hit the target.

Finally, samples from each lot of finished ammunition must be test-fired at regular temperatures and at extremes of heat and cold before it is turned into distribution channels with our stamp of final approval.

This careful step-by-step inspection and testing has paid off. We have the safest to handle and use, the most accurate, most effective, and most dependable ammunition in the world. But the process takes time.

Even with most expeditious handling, this cycle of testing, shipment, loading and assembly, testing, and final release consumes about two months more, added to the production lead time for the metal components.

This matter of lead time is the hard fact of life that controls the deliveries and, therefore, the expenditure of funds devoted to the production of ammunition.

In every war it has been the same, and every military man and industrialist in the production field has had to contend with a general unwillingness to recognize the fact that complicated military items cannot be produced overnight by industry previously devoted to other types of manufacture.

Lead Time

The importance of lead time in its influence on rate of expenditure of funds—or production—becomes apparent when it is realized that during fiscal year 1951 over ninety per cent of the dollar value of ammunition orders placed went to contractors who required either new facilities, production equipment, or the rehabilitation and reactivation of Government-owned plants before commencing production. For 1952 the proportion was about sixty per cent.

To keep pace with the steadily increasing needs for ammunition we are still bringing in new producers who will not reach substantial production until eighteen months from now.

Thirty Months Needed

With the most expeditious action in placing contracts, with the best efforts on the part of industry, and every possible assistance from Ordnance, it takes about 30 months—2½ years—from the date of availability of funds to liquidate completely, by deliveries and expenditure, the money committed to a new producer on a first order for reasonable quantities of an important ammunition item.

This time schedule changes gradually as a greater percentage of continuity orders can be placed with going producers. At best, however, a normal one-year production run requires twenty-one months to liquidate the contract completely, since funds must be available to Ordnance for the new order, on the average, nine months before production ends on the previous order.

These are the cold facts with respect to the *rate* at which production can be secured when started virtually from

zero, as was the case in the present emergency.

The *quantity* of ammunition that can be produced depends, of course, on the amount of money put into the ammunition program and *when* it is put there.

Greater Production

If very large sums had been allocated to ammunition production shortly after the Korean outbreak instead of in increments throughout the two years, initial production may not have started sooner, but the number of producers and the total production could have been proportionately greater.

Comparison with the period 1941 to 1943 under the mobilization conditions of all-out war will show this very clearly. In no year of that war were production goals fully achieved. Yet because the goals were higher, the total production was higher.

In the light of these facts, the curve [on chart A, p. 49] showing expenditures, which of course means production, represents good achievement. You will note that total expenditures by the end of this month exceed the total of $2.9 billion available for ammunition procurement during fiscal year 1951.

There is a slight increase in the total lead time when new large amounts of money are made available for ammunition procurement, but the general position improves as we are able to place continuity orders with going producers, provided new money is available far enough in advance to maintain the rate of production.

In spite of many complex problems and some unfortunate delays which are easy to evaluate after the fact, the combined efforts of industry and Army Ordnance have achieved a rate of increase in ammunition production that compares favorably with the past performances in the same field.

Quality Improved

We have greatly improved the quality and the safety standards of our ammunition over World War II production. There is substantial capacity in production today and new facilities are still being brought into production. Production rates for the most important types of ammunition—those that have been short in every war—are mounting every month.

These achievements have been accomplished in full accord with the laws and regulations governing procurement during this limited emergency. The output of the ammunition production lines is being distributed in accordance with priorities and allocations set by the established authorities.

I do not mean to say that I am satisfied, or that no mistakes were made. In a program of this size and complexity it is inevitable that there will be some errors—errors that are easy to evaluate after the fact. For example, had we been able to appreciate fully in advance the problems that occurred in the production of 105-mm. steel cartridge cases due to technical difficulties, we certainly would have expedited our program for the recovery and reuse of fired cases.

I consider ammunition to be the most essential of the munitions of war and the one most susceptible to unpredictable changes in requirements. I feel that the only successful philosophy, as applied to production and to reserves of ammunition is that we must have "too much, too soon" rather than attempt to meet requirements by a piecemeal approach.

Strongest Efforts

Army Ordnance will continue to exert its strongest efforts in this field to the limit of funds, objectives, and authorities allowed to us. The money presently available behind our ammunition contracts "will be spent" as rapidly as the combined efforts of industry and Ordnance can convert contracts into finished ammunition.

Meantime, the rate of increase in production and adequate available funds to carry the program are the two best indices of real momentum. In the last analysis, "adequate available funds" means unspent money.

If ammunition production is to continue at a high rate in the future, new funds must be available in time to be converted into contracts and allow producers essential lead time before presently available unspent money is used. For the bulk of the ammunition program currently funded, orders will run out twelve to fifteen months from now.

Much detailed information has been made available to representatives of this subcommittee by my organization, and we are ready and willing to answer any further questions.

THE SUPPLY OF MATERIALS

At one time the supply of hot-rolled round steel bar for shell manufacturers using the cold-extrusion process was a cause of concern, and it has limited the number of contractors we have dared to allow to use this very efficient process. It has been necessary to steer most of our shell contractors toward World War II methods of fabrication simply because the type of billet steel that could be used could be produced in almost any steel mill and because the demands of commercial production did not seriously compete with that type of steel.

Today our most serious materials problem is the availability of steel for cartridge cases. This is a type of plain carbon steel but one that must be made to exacting standards. It is normally supplied in the form of disks from the steel mills directly to the cartridge-case contractor. The first steel company in this business after July 1950 was Armco, which had pioneered in cartridge-case steel during the Second World War.

Later Inland and Bethlehem were encouraged to undertake the supply, and those three today are the sole sources for maintaining our cartridge-case industry. Their output will not be enough for the industry two months from now. Although NPA has assured Ordnance that our needs will be met from other sources, Ordnance thus far cannot share that optimism.

Were we to throw over any important part of our artillery cartridge case production into brass, a copper shortage in the country would result at once. That is definite and is not the answer to the problem. Nevertheless, we have had to stockpile brass disks against potential shortage of steel disks.—*From a statement of Brig. Gen. Merle H. Davis, chief of the Ammunition Branch, Industrial Division, Office of the Chief of Ordnance, included in General Ford's testimony before the Senate Subcommittee.*

James L. Walsh Prize Essay Contest

As announced in the last issue of ORDNANCE one thousand dollars in cash will be awarded by the American Ordnance Association for the best essay in the field of ordnance preparedness.

● The award will be made annually by the Association in memory of its late president who was one of the founders of the Association, Col. James L. Walsh.

● All members of the Association who have not reached their thirtieth birthday are eligible to enter the contest. The prize-winning essay will be published in ORDNANCE magazine, the bimonthy journal of the Association. All essays submitted will be considered for publication in ORDNANCE. Authors of nonprize-winning essays will be paid the usual publication rates for articles if published in the magazine. The topic for the 1953 contest will be:

> ***"It is sometimes said that modern weapons have become so complex that their use and maintenance can be assured only by engineers and technicians of more than average skills. Discuss the truth of this opinion in the light of manpower limitations and what steps might be taken to assist in the solution of the problem."***

● To be eligible, essays must be submitted on or before October 1, 1953. Articles must not exceed 3,000 words. They must be typewritten, double-spaced, on paper approximately 8½ by 11 inches, and must be submitted in triplicate, each copy complete in itself and firmly bound together.

● The name of the competitor must not appear on the essay. On the essay a *nom de plume* will be used. The name and address of the contestant must be typed on plain paper and inserted in a plain sealed envelope on the front of which his *nom de plume* must be written.

● Essays with identifying envelope must be mailed in a large sealed envelope marked "Walsh Prize Essay Contest," to the Secretary, American Ordnance Association, 705 Mills Building, Washington 6, D. C.

Army photo

Ordnance Reliability through Quality Control

Maj. Gen. Leslie E. Simon

Assistant Chief of Army Ordnance for Research and Development

"WHAT is past is prologue." This motto is engraved in stone on the base of a monument outside the Archives Building in Washington. A story is told of a Washington tourist who observed the inscription and asked his taxi driver what it meant. After some hesitation, the driver replied with more perspicacity than he knew, "That means you ain't seen nothin' yet!"

For One Purpose

Experimentation, testing, and the taking of data are primarily for one purpose—to make predictions. The fact that, in the past, a sample of things were tested and a percentage failed is of little intrinsic value. The really important results of the test are:

1. The inferences that may be drawn about how the untested remainder of the things will perform in the future, and
2. The changes that may be made in the things yet to be produced so as to reduce the percentage of failures therein.

Quality-control procedures can do much to assist in treating tests and experiments as prologue to a more satisfactory future rather than consigning the data with much of its vital content to the archives.

Furthermore, if the quality-control procedures that have done so much to improve the reliability of ordinary manufactured products can be adapted to the large problem of reliability of complex equipment, perhaps we "ain't seen nothin' yet."

Transition Not Easy

The transition from control of a product of a factory production line to control of a complex assembly from many production lines (such as a guided missile) is not easy. The military technical services are in the same dilemma as much of the rest of modern society in that men know in large part what the answers to many of their problems should be but do not know the *methods* that should lead to the solutions of the problems.

Briefly, and almost facetiously, we know the answers; it is the questions that we do not know. This anomaly is inherent in the scientific method which can be characterized as the orderly procedure from *hypothesis* to *experiment*, to *judgment* of hypothesis, and around the sequence again and again.

Many Hypotheses

Hypotheses are generally in ample supply, even though good ones may be largely dependent on genius or intuition. The volume of suitable hypotheses is attenuated in a practical way by the criterion that the solution to the problem at which they are aimed should be potentially feasible in the existing state of science and technology.

Scientific progress is limited also in marked degree by the analytical ability of the experimenter in devising means for the experimental verification of the possible alternative answers that have been postulated.

Quality control has contributed much to the realization that analytical acumen is keenly sharpened by prior organization of work into various types of experimental designs.

The variability in data is known to have a very important bearing on the confidence that can be placed in them. The accuracy and precision of measurements (dealing respectively with the general level and the scatter of the values) have come to have relatively well defined meanings.

It is realized that the amount of testing that needs to be done depends

on the variability to be expected when all the surrounding conditions have actually been constant. The questions of when, and where, and how much to sample and test can be answered by designing an experiment which will permit assessing the importance of all the known sources of variability.

The concept of using inherent variability (the variability still present in a state of control) as the basis for determining when real changes in product or process have occurred has been extended to manufacturing chiefly through the use of control charts.

Parallel Growth

Since building reliability into complex systems seems analogous to and, in part, predicated on quality control, let us take a look at the parallel growth of quality control and the growth of complexity of military equipment.

The first Ordnance item to be fully subject to statistical quality control was the simple artillery primer. This work was done at Picatinny Arsenal in the early 1930's. It was no spectacular achievement. It resulted merely in somewhat more reliable, more uniform artillery primers at lower cost.

The system was soon expanded to many munitions components, such as fuze parts and the explosive filler of artillery shell, but it was not until World War II that quality control was applied to a whole munitions assembly, the small-arms cartridge. The work paid great economic dividends in World War II, and the work of World War II, in turn, paid great dividends to the science of quality control.

However, it was not until the Korean war that this scientific discipline was extended to a whole ammunition system, the 105-mm. howitzer ammunition.

A complex system must be brought under control in order to establish statistical quality control of the complete round of ammunition. The illustration on page 56 shows a 105-mm. howitzer in action in Korea.

The complete-round assembly line is in a plant covering hundreds of acres, into which flow from all parts of the country fuzes, boosters, empty projectiles from various metal-parts manufacturers, high explosive for filling the shells, empty cartridge cases, smokeless powder, and other components.

Suppose that one can establish quality control on each important operation of the complex assembly line; is that enough? By no means!

One soon discovers that, to have real reliability, the control system must extend back to the maker of the empty shell so as to control reliably the cavity and the weight of the empty shell. Similar controls must tie in the work of the contractors for other parts, the work of their subcontractors, and sometimes must extend to sub-subcontractors.

Similarly, controls must be extended forward to the sampling, testing, and analysis procedures of the proving grounds.

The quality-control procedures covering all these problems for a typical assembly line recently were devised and installed by the Quality Assurance Group of the Bell Telephone Laboratories under contract to the Industrial Division of the Ordnance Corps.

This work could hardly have been possible at a very much earlier date because it required for its fruition the creation of new knowledge by the joint work of science, industry, and government, the broad dissemination of this knowledge, and the training of many engineers in quality control.

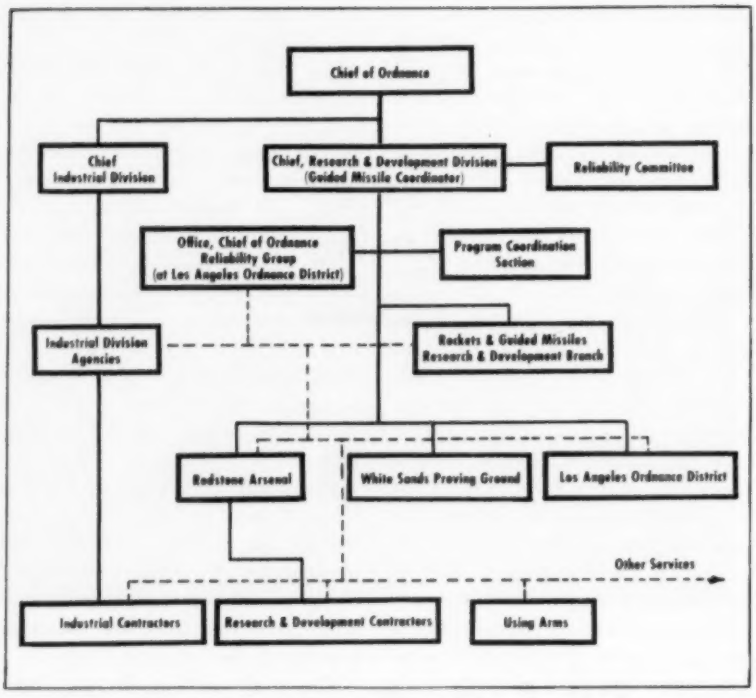
Let us glance at a few of the advantages and benefits of this piece of work. The average lot of ammunition during World War II was between 3,000 to 4,000 rounds. The 105-mm. ammunition shipped to Korea recently has been in uniform lots of nearly 150,000 rounds.

Enormous Saving

When one considers the fact that the artilleryman must fire trial fire to establish the calibration of each lot, one sees that the ammunition saving is enormous. However, what is far more important is the increased accuracy.

The dispersion of this ammunition is a small fraction of the dispersion of the general run of ammunition that has existed heretofore, thereby insuring more hits on the target in less time, at the place and the time that they are needed. It is probably the most marked advance in ammunition that has occurred since the introduction of smokeless powder.

An experimental guided missile takes off aided by booster rocket.


Chief of Ordnance
Chief Industrial Division
Chief, Research & Development Division (Guided Missile Coordinator)
Reliability Committee
Office, Chief of Ordnance Reliability Group (at Los Angeles Ordnance District)
Program Coordination Section
Industrial Division Agencies
Rockets & Guided Missiles Research & Development Branch
Redstone Arsenal
White Sands Proving Ground
Los Angeles Ordnance District
Other Services
Industrial Contractors
Research & Development Contractors
Using Arms

Proposed guided-missile reliability organization for Army Ordnance. Solid lines show command channels, dotted lines indicate liaison and information flow.

At the same time, economies introduced in the process not only pay for the new procedure, but it is also probable that the savings on the first large lot offset all the money that Ordnance has spent on quality control since World War II.

The transition from quality control of the primer to quality control of the complete round of ammunition seems great. However, the step from the complete round of ammunition to the guided missile is much greater.

The V-2 Rocket

Let us consider the German V-2 Rocket. Meticulous as the Germans were about mechanical and engineering precision, about twenty-five per cent of the V-2's failed on launching, and about twenty-five per cent more failed while en route to the target.

Their launchings were under relatively favorable climatic and interference conditions, and their missiles had not undergone any prolonged storage. A fifty per cent failure in items as expensive as missiles is overwhelming.

Modern guided-missile systems are even more complex in terms of the total number of parts in the structure as well as in the design of these many parts. Although the design details are not available, some idea of the nature of a modern guided missile may be obtained from the photos on pages 57 and 59. The high degree of complexity increases the chances of failure.

By way of further discouragement, because guided-missile systems are new, the conditions that they will experience in use are necessarily very imperfectly understood. Therefore, we are compelled to work continuously on the frontier of existing knowledge in both science and technology.

The tremendous efforts being expended on the general technical aspects of guided-missile development increase rather than diminish the effort that is required to achieve and maintain reliability.

However, all entries are not on the debit side of the ledger. Complexity of equipment is no absolute barrier to the achievement of reliability, if competent and conscientious men earnestly attack the problem.

The Electronic Numerical Integrator and Computer (the ENIAC) is an extremely complex device that contains over 30,000 vacuum tubes, in addition to thousands of other components. When it was first delivered to the Ballistic Research Laboratories, Aberdeen Proving Ground, Md., it had a reliability of about five per cent, in the sense that it could be made to operate satisfactorily only that percentage of the time.

Reliability Raised

In a matter of weeks, a small crew of engineers raised its reliability to seventy-five per cent, and it was subsequently raised higher.

In fact, the compounding of variables, although confusing from the engineering viewpoint, is not necessarily unfavorable to quality control. Shewhart has shown that the approximation of the normal probability density distribution is enhanced by increasing the number of variables compounded. It is the dull subject of organizing for the task that is initially of principal concern and not the means—not even the probability of ultimate success.

Complex equipment, such as guided-missile systems, offers a challenge to the quality-control profession. It will require a higher degree of organization of all activities involving reliability of performance than has usually been considered necessary.

As expensive as missiles are, every piece of valid data must be gathered and utilized—from the inspection results of the production line to the target-practice results acquired in the training of troops.

Discover Cause

We must know not only that a failure occurred; but, if practicable, what part caused the failure and why. We must then see to it that the cause system that produced the defective part is discovered and corrected and, in serious cases, modify the unused items that were produced prior to the correction.

Such a program calls for an organization within government, but it must be one which will influence even the subcontractors of contractors for component parts to install quality control.

Such influence can be exerted at least

through the medium of good acceptance inspecting such as that done during the war in accordance with the Ordnance Sampling Tables.

The chart on page 58 gives an idea of the reliability organization contemplated for the Ordnance Corps. Although the ultimate responsibility is shared by all who have a part in the missile program, this *ad hoc* organization should help to correlate all the efforts and to focus attention on the most critical aspects at any given time.

The special problems of quality control, acceptance inspection, check-out before firing, feedback of test results, measurement of environmental conditions, planning of component tests, and other problems are covered in the overall plans for functioning of the organization. The proposed organization, when completely effected, will consist of:

1. A Guided Missile Commodity Coördinator who will coördinate all aspects of the guided-missile program.
2. An Ordnance Guided Missile Reliability Committee with representation from all branches of Ordnance concerned with the problem that will advise the Commodity Coördinator on reliability aspects of guided missiles.
3. A small permanent working group known as the Office of the Guided Missile Reliability Coördinator, that actually will perform over-all liaison and coördination.
4. An arsenal reliability committee to coördinate arsenal matters concerning design and procurement, feeding information from and to the permanent group.

5. A permanent reliability office at the missile proving ground to coördinate the engineering evaluation of the systems and similarly to feed information.
6. The assignment of liaison and coordination responsibility in reliability matters for specific missiles to individuals or groups in each of the following: development agencies and subcontractors, production agencies and subcontractors, Ordnance inspection and test agencies, Ordnance maintenance and field agencies, and the using forces.

Each segment of this organization will have specific responsibilities for improving and maintaining the reliability of the product. It is to be noted that the organization is primarily one of liaison and information flow, with actual command remaining in the normal channels.

Recommend Policy

The Ordnance Guided Missile Reliability Committee will recommend the basic Ordnance policy on reliability organization. The Office of the Guided Missile Reliability Coördinator will coordinate the reliability effort for the entire Ordnance guided-missile program. It will report directly to the Guided Missile Commodity Monitor in the Office of the Chief of Ordnance and will be competent to assist either Government agencies or private contractors in developing their individual parts of the reliability program. It will accomplish its operations normally through recommendations, relying on the normal command function only if required.

Each group or installation handling the missile or missile components must designate some of their personnel to be responsible for reliability matters. The collection of needed information will be expedited by well-organized channels of communication.

The organization plan provides a channel for information not only within Ordnance but also between Ordnance and the using arms, between Ordnance and the other services engaged in guided-missile developments, and between Ordnance and the industrial contractors involved in design and in the production of missiles and their components.

It also provides a channel for direct flow of information among each of the non-Ordnance agencies. The plan involves people who are competent in engineering, people who know how to design test programs, and people conversant with acceptance-sampling plans and the technique of quality-control procedures.

Testing Limited

Since the amount of complete systems testing that can be done is limited both by time and particularly by cost, unusual detailed attention must be given to adequacy of design and satisfactory control during manufacture for guided missiles.

The really basic approach consists of applying long-established procedures for making the parts and assemblies as uniform and of as high a quality as possible. Quality must be assured long before the final and destructive flight test takes place. This means that many contractors and subcontractors not using statistical quality control to its fullest extent must be persuaded to do so.

Flexibility Needed

Undoubtedly, some parts of the present plan will prove inadequate in the light of unforeseen aspects of the problem, requiring an innate flexibility of the plan to adjust to established conditions. There has never been a time when science and industry have not given Ordnance every available support, and the same teamwork that has brought conventional ammunition to its present high state of perfection will also make certain that our new problem child, the guided missile, is at least acceptably reliable.

THE THIRTY-FIFTH ANNUAL MEETING

of the

American Ordnance Association

will be held at

ABERDEEN PROVING GROUND, MD.

on

Thursday, October 8, 1953

with the approval of the Secretary of Defense
and the coöperation of the Chief of Ordnance of the Army

Under the auspices of the Commanding General of Aberdeen Proving Ground a day-long schedule of current tests and demonstrations of the modern weapons of our fighting forces will be witnessed by the members of the Association.

Complete details of the meeting, including reservation forms and railroad schedules, will be mailed to all members on September 1, 1953.

Meanwhile, mark the date on your calendar and plan to be with the Ordnance fraternity for the celebration of Ordnance Day at Aberdeen Proving Ground, Md., on Thursday, October 8, 1953.

Army photo

The Case for Tanks

Armored Units Are Versatile Weapons In Offensive or Defensive Tactics

Col. Fred Thorlin

JUST prior to the Korean outbreak in June 1950, many people—including some prominent government officials—believed that tanks were practically obsolete. Such people felt both the Army and Marine Corps were wasting time and money even in training with tanks already produced. Certainly, they opined, no more money should be spent on new tanks.

Tanks in Korea

These thoughts, pleasant as they might be, were quickly dispelled when the same people heard how effectively tanks were used by the North Koreans in the opening offensive of the war. The North Koreans used medium tanks in mountainous so-called "nontank country" to spearhead the long-remembered attack which forced our troops and their light reconnaissance tanks southward, almost to the coastal city of Pusan itself.

The chant then changed from "Tanks are obsolete" to "Where are our tanks? Let's hurry up and make some new ones."

Fortunately, to handle the enemy tanks in Korea it wasn't necessary that we make new tanks. The problem simply resolved itself into replacing the light reconnaissance tanks with U. S. medium tanks—in time.

Once there, these medium tanks, World War II Shermans and very early Pattons, were more than a match for the second-hand T34 tanks which had been provided the North Koreans by the U.S.S.R. (For reasons best known to themselves, the Soviets have not yet seen fit to provide modern tanks to North Korea.)

Little is now heard of tank warfare in Korea primarily because of the static battle line that presently exists and, incidentally, because enemy tanks do not dare to oppose our tanks in duels.

Not Obsolete

The silence on tank activities in Korea, coupled with increased publicity about push-button warfare and guided missiles, seems to be lulling people again into the belief that tanks are obsolete. Nothing could be farther from the truth. If anything, tanks are of more value now than they have ever been in the past.

The possibility of atomic warfare in the future has opened up a whole new additional field for which the tank is just what the doctor ordered. On the defense, it can withstand atomic explosions much better than any other weapons system. On the offense, it has the ability to move quickly into and to exploit an enemy area that has suffered atomic bombardment, with relative immunity from any residual radioactivity that may be present on the ground.

Will Remain Useful

People who deem the tank obsolete apparently do not realize that their opinion is not shared by top military authorities anywhere throughout the world. These authorities agree, by words and action, that a completely armored, crew-served, self-propelled gun (*i.e.*, a tank) is, and will undoubtedly continue to be, very useful to any modern army.

In the United States, fiscal year 1951 saw the initiation of an intensive program to build tanks, principally mediums, in sufficient numbers and qual-

Colonel Thorlin served on the Joint Army-Navy Staff under Admiral Nimitz during World War II. He is now chief of the Tank-Automotive Development Branch in the Office of the Chief of Army Ordnance, Washington, D. C.

ity which would permit our Army and its allies to meet any enemy use of force. Certainly, U. S. authorities do not consider the tank obsolete.

Some people are of the opinion that modern bazookas have made the tank so vulnerable as to be substantially obsolete. This is not true. Admittedly a bazooka can knock out a tank at very short ranges, but the fact remains that, in spite of the great numbers of bazookas used, not more than two per cent of the tanks in World War II were lost in that manner.

The reason? Very few bazookas ever got within damaging range of a tank. Why not? The tank's machine guns usually reach out and splatter suspicious hideouts long before the tank is close enough to be hurt by a lurking bazooka. And if this were not enough, the infantry accompanying the tank scour the ground to make sure no bazooka has been overlooked by tank fire.

Summarizing, as long as wars can be brought to a conclusion only by physically occupying strategic enemy ground, an army will be needed. And as long as an army is needed, tanks will be needed. They, together with airplanes, ships, and artillery, make it possible for the infantry to take actual possession of ground with minimum casualties and expense. When infantry is obsolete, tanks may become obsolete—but not before.

Contrary to general opinion, Army Ordnance itself does not decide that a new tank is needed. That decision is made by the General Staff usually upon the recommendation of the Army Field Forces, who are the principal users of tanks in battle.

Tasks Outlined

The requirement is couched in the so-called "military characteristics" which describe in general terms what military tasks the new tank shall be capable of performing on the battlefield.

As might be expected, the user often wants a Cadillac for the price of a Chevrolet. Or he might, in effect, ask for a tank which is "big on the inside but little on the outside." After considerable debate and a review of feasibility studies, agreement on what can be designed within the limits of technical know-how is finally reached.

Army Ordnance then proceeds to write technical specifications, intelligible to industry, covering the new tank. Ordnance also provides necessary technical military guidance and interpretation of the military characteristics to insure the development of the best possible tank.

Incidentally, Army Ordnance not only procures tanks and other automotive vehicles for the Army but also for the Navy, Marine Corps, and Air Force. The procurement of Department of Defense vehicles is truly a unified process.

Army Ordnance then usually contracts with industry for the development of a pilot model of the tank or it may, in special cases, have the work performed at a Government arsenal. About eighty per cent of Army Ordnance research and development work is performed by industry.

Evolution Begins

The evolution of a pilot model of a new tank begins: Layout drawings, conferences, small-scale wooden models, detail drawings, full-scale wooden mock-ups, conferences, more detailed drawings, and, finally, a metal prototype.

After that comes a period of testing, modification, and retesting at Aberdeen, Fort Knox, in the Arctic, in the desert, and in the tropics.

The reader should realize that new tanks are not produced overnight. In fact it takes from three to six years before a new tank comes off the production line after agreement is reached on the general, over-all, design parameters.

The exact length of time, of course, depends on several things—the unusualness of the design and its components, the length of time the pilot model is tested before being released for mass production, the number of "bugs" in the pilot model, etc.

A "bugless" pilot-model tank has yet to be made. This, of course, is no news to the automotive industry which has the same problem with the first pilot model of any new car, particularly if the change is other than a body design change.

While the telescoping of development and production may save time in certain emergencies, it nevertheless results in considerable extra expense. In the author's opinion, a continuous year-in and year-out tank research and development program is the best way to attain relatively inexpensive tanks—on time. "Feast and famine" budget programs are always the most expensive in the long run.

Uses Not Understood

With the above general background, it is well that we now more closely examine the rôle of the tank in modern battle. While every American boy can discuss strategic and tactical use of airplanes with some degree of intelligence, there are very few people who have a clear idea of the uses of tanks in war.

This general lack of knowledge is probably the principal reason that uninformed people are prone to shrug off tanks as being obsolete and unnecessary. So let's look at some of the rôles in which a tank "pays its way." At the same time we will put ourselves in a position from which we can more intelligently assess the merits of our new tanks.

Tanks are not restricted to the sole rôle of fighting tank duels. Duels, in fact, are one of their more unusual rôles. Tanks are actually very versatile weapons and well suited for several different tasks. They are useful in the attack, in the counterattack, in retrograde movements, and in the defense. In short, they are useful in practically all phases of combat.

Probably the most important duty of armor is that of exploitation on the attack. In this rôle tanks are used in mass, not singly or in small numbers. The stage is set for this action when the artillery bombardment, both air and ground, the infantry, combat engineers, and infantry tanks—all working together—have opened a hole in the enemy line. Tanks quickly take advantage of the situation and pour through the hole with speed and surprise.

Army photo

Working together as a team, tanks and infantry make a hard-to-beat combination on the attack.

The enemy, already disorganized by the shelling, is suddenly confronted with crushing steel monsters spurting out a demoralizing volume of concentrated firepower. With spectacular broken-field running, these tanks tear into the vitals of the enemy including its sensitive rear elements. So rapid is the advance of the tanks that the enemy has very little time to prepare for the attack.

Demoralizing Effect

Fear and an overwhelming desire to live replace the enemy soldier's judgment and sense of duty. This shock action of the tank has a psychological, demoralizing effect which spells immediate disaster to all but the most resolute soldiers. It is not unusual for such a battle to be started and finished in less than an hour.

An enemy being destroyed as pictured above is almost certain to throw in his reserves and execute a counterattack—a counterattack strong in tank strength. Here is where superior tanks on our side will pay off so that we can destroy the enemy tanks and proceed with the mopping-up operation.

The best defense against an enemy tank counterattack is a better tank—better in firepower, mobility, and armor protection. An enemy counterattack is doomed when pitted against tanks which can defeat the enemy tanks and at the same time stay out of their effective range. This, by the way, is one of the reasons our Army insists on high first-round hitting ability for its tanks.

Tanks are also used in smaller numbers. When they are used as an integral part of the infantry organization, a company of tanks usually is available to an infantry regiment. In this rôle they are integrated with the infantry and help the infantry capture enemy ground. As such they are organizationally tied to the mobility of the infantry. Designwise, however, the same tanks can be used by highly mobile, speedy troop units.

The tank knocks out enemy pillboxes and opposing tanks which otherwise would stop or delay the advance of the infantry. The infantrymen, on the other hand, support the tank by protecting it from mines, bazookas, recoilless rifles, and other close-range threats.

Almost without exception, tanks are always accompanied by infantry—either walking, riding on the tank itself, or in closely following armored personnel carriers.

Tanks are also very well suited to play a key rôle in retrograde movements, particularly the delaying action which is one of the most difficult of all military operations. In this type of maneuver outnumbered troops delay or slow down the advance of numerically superior enemy troops by successively trading ground for time. Just as soon as the enemy has finally rearranged his troops from the traveling formation to the battle formation, the smaller forces break off the engagement.

They withdraw to another rearward battle line just far enough way to force the enemy to again pack up his equipment and go back into a road formation. Such tactics on the part of the delayer can be fatal if the timing of his withdrawal is not just right or if insufficient covering protection is given his troops as they retreat in the open from the first battle line to the next line some miles to the rear.

Can Hold Off Enemy

Who can best stay and hold off the enemy until the troops are in position on the second line? Yes, tanks, because they have armor protection to take a pounding, a lot of firepower to deliver, and only a few men are required for the job.

These tanks provide a good screen of fire against the enemy until the rearward movement is completed. At that instant the tanks speedily get out of

there and live to fight another day.

Retrograde movements are, of course, unpopular and distasteful to Americans. However, we well might find ourselves in such a position in case of a sudden outbreak of war in Europe. It is necessary, therefore, that we have the wherewithal, including tanks, to trade ground, as little as possible, of course, for time in which to get set.

Reconnaissance

Still another mission for which tanks, particularly light tanks, are well suited is the reconnaissance and flank-security rôle. In this case the tanks operate much the same as horse cavalry did in the past. In very small groups they probe into the unknown and observe and report enemy forces and activities. Because they have tracks, rather than wheels, they are not restricted to roads and can get to the best place to observe, almost regardless of topographical location.

Once there, their excellent gun-sighting instruments are used to scan the area. The armor protection afforded by the tank is, of course, conducive to deliberate operations on the part of the crew. And last but not least, the tank is equipped with a good gun which can beat off those who would try to prevent it from obtaining or returning home with the vital information.

Another rôle—a sort of slugger rôle—for tanks is the knocking out of heavy enemy tanks and heavy antitank gun emplacements, bunkers and pillboxes. In this rôle heavy tanks are generally used. The heavy slugger tank sits back and watches the smaller tanks of its family much as a bear watches over its more maneuverable cubs at play. When the smaller tanks come up against something they can't handle, the slugger tank lashes out with its long-range, very powerful artillery.

Tanks are also extremely well suited to the creation of powerful diversionary attacks. Their high firepower causes the enemy to resist their attack with considerable effort and expense. The tanks, however, with their great mobility, can break off the diversionary attack at the moment of their choosing and promptly join the main attack, often at a critical time.

From the foregoing it should be evident that tanks are not used solely for tank duels but are instead very versatile, essential weapons. They have certain valuable military characteristics not found in any other weapon or, for that matter, in any other group of weapons. They do a job which cannot be done as well by any other weapon.

A close study of the missions or rôles assigned tanks should indicate to the reader that different degrees of firepower, mobility, and armor protection are required. For example, the primary characteristic of the tank used in the reconnaissance and security rôle is obviously mobility (speed). Firepower (gun size) sufficient to engage enemy forward elements or for effective safe withdrawal is secondary. Armor protection must, of necessity, be last, since a heavily armored tank is hardly speedy.

On the other hand, if the tank is to be used as a mobile antitank gun—a slugger which can knock out the toughest enemy tanks threatening the infantry or smaller tanks—then great firepower is the primary characteristic. Armor protection and mobility follow in that order. Somewhere between these two extremes is a tank which has the optimum firepower, mobility, and protection for general all-round use.

Three Classes

To attain a well-balanced, economical tank team it is obvious that three classes of tanks must be provided: A reconnaissance-security tank (light); a general-purpose tank (medium); and an assault tank (heavy). Of the three, the medium is the backbone of Armor and perhaps the most important of all.

The terms light, medium, and heavy, refer primarily to the gun. They are usually, but not always, indicative of the relative weight. In modern armies, light tanks generally weigh from 15 to 25 tons, mediums from 30 to 50 tons, and heavies from 50 to 65 tons.

For logistical reasons and training simplification, it would be ideal to use only one class of tanks. However, we feel this to be tactically impracticable and uneconomical at the present time.

Have you ever been asked by a friend, "What's the best car to buy?" What he means is, what is the best car *for him* to buy. That's a tough question—depends on whether he wants prestige or just transportation, performance or economy, how much money he can spend for a car, how he is going to use it, how long he intends to keep it, and ever so many more considerations. In the end he buys a certain kind of car using his—or more likely his wife's—best judgment. Likewise the best judgment of the U. S. Army is used in buying the "best" new tank.

Compromises Necessary

Just as there are compromises in the design of passenger cars, there are compromises in the design of a tank. To be superior on the battlefield a tank must have the best combination of the three key, but mutually incompatible, characteristics: firepower, mobility, and protection. If one or two of the characteristics are overemphasized it must be at the expense of the third.

Therefore, the best combination to be designed into a tank is a matter of judgment—judgment which must consider the present and probable weapons (not just tanks) of aggressor nations, our battle tactics as well as those of a possible enemy, possible and probable geographical areas of combat, etc. Even the American soldier's psychology must be considered in tank design.

In addition to the purely military aspects, the cost in both dollars and national resources must be carefully considered. It should be clearly realized, however, that whether our tanks are optimum in design for our purposes depends on the accuracy of our present tactical and strategical judgment of things to come.

"As long as wars can be brought to a conclusion only by physically occupying strategic enemy ground, an army will be needed. And as long as an army is needed, tanks will be needed. . . . When infantry is obsolete, tanks may become obsolete—but not before."

We have been mentioning these terms—firepower, mobility, and protection—as being prime characteristics of any military weapon. Suppose we look into these characteristics from the tank aspect and try to deduce what is involved and how it affects the design of tanks.

By tank firepower we mean the bringing of a large volume of lethal fire upon enemy personnel and matériel, including enemy tanks. A tank gun which can get a penetrating hit on an enemy tank with the first round fired is obviously also very satisfactory for use against the other targets a tank must handle.

Antitank Performance

Therefore, the tank gun and its fire control are usually designed for good antitank performance. Such design requires a powerful main-gun-and-ammunition combination, accurate range determination, precise sighting equipment, speedy operation in the tank turret, adequate space for ammunition, and an adequate number of machine guns.

A powerful gun-ammunition combination means many things to many different people. Of the two, however, the ammunition is perhaps the more important element. Its performance at the target is the important criterion, not the size of the gun which launches the projectile.

Accurate range-measuring devices are normally essential in order to get a hit with the first round fired at a target which may be a mile or two away. Optical or electronic range finders—often referred to as "gadgets" by uninformed people—are usually employed.

Precision Demanded

Precise sighting equipment means just what is says—precise. The precision is not unlike that of a surveyor's transit. Without such precision, the tank's limited ammunition supply would soon be wasted and exhausted, leaving it impotent for a normal day of battle operation.

Often forgotten when talking about tank firepower are the tank machine guns. These are important when one realizes that the mission of the tank, in the final analysis, is to close with the enemy and shoot up disorganized troops. The tank's caliber .30 and .50 machine guns are the most efficient, effective means of doing just this. In a sense the main gun on the tank is used to clear the way so that the machine guns can be brought to bear on the enemy troops.

"Army Ordnance has never forgotten the costly headaches which resulted from using four different types of improvised engines in just one class of tanks—the medium tanks of World War II. . . . Since then, Army Ordnance has been able to develop a family of standard air-cooled tank engines that can be used in many different military vehicles."

Now let's consider mobility. By mobility we mean good automotive performance which enables the tank to go from Point A to Point B, over any kind of rough ground, quickly and surely. To go quickly, up to 45 miles an hour in some cases, the vehicle must have a good horsepower-to-weight ratio; that is, the engine should be powerful and the vehicle should be light.

As a rough rule of thumb, the horsepower-per-ton ratio should be in the neighborhood of 20; that is, a 25-ton tank should have an engine delivering about 500 horsepower.

To cross rough, muddy ground surely, the vehicle must be provided with wide tracks which have low ground pressure. In this connection it is interesting to note that the tracks of a 60-ton tank bear much less heavily on the ground than do the tires of a light wheeled passenger car. The tracks must be designed to operate effectively in sand, snow, mud, shallow water, or on roads. Complete automotive reliability in any climate—arctic or tropical included—is required because we never know exactly where we may have to fight.

The transmissions, usually fluid torque-converter types, must be nonfatiguing to operate and easy to maintain and produce.

Tractive effort (pulling force) must be great—equal to at least half of the vehicle's weight in order to climb very steep grades. Range of operation and fuel economy are also important facets of mobility since they determine the depth to which an armored unit can operate beyond its logistical base.

Protective Factors

By protection we mean armor plate properly sloped to protect the tank crew from most enemy hits. (Notice that we say *most* enemy hits. We cannot make a tank which will give complete immunity to the crew under all circumstances and still be a useful vehicle.) The artillery concentration on the objective and the infantry who accompany the tank furnish additional protection for the tank. Low silhouette, quiet operation, speedy evasive action, are, of course, other factors which provide inherent protection.

If our gun-ammunition combination can outrange the enemy, we realize considerable protection. If our mobility is good we make a difficult target for the enemy and hence realize a good portion of protection. It is therefore evident that protection is definitely allied with firepower and mobility. Nevertheless, as good insurance against surprise hits, good shock-resistant armor plate, properly sloped, is necessary.

The cost of such protection, of course, is weight. This weight can be reduced by (1) development and use of lesser-density armor plate and (2) by developing more compact automotive components—*e.g.*, engines and transmissions—which require only a small envelope of armor plate. Army Ordnance is working actively along both these lines in order that tanks may be well armored and yet reasonably light.

What Does It Cost?

Although firepower, mobility, and protection are the most important battle features of a tank there is, nonetheless, another far-from-glamorous feature which must be considered by the tank designer. That is cost—total military cost. Total military cost might be thought of as the over-all cost of the tank to the Government from the time it is conceived until the time it is destroyed in combat.

As such it includes not only the initial cost of the tank as it comes off the production line but also the crew-training cost (schools and time), the operating cost (fuel, lubricants, and ammunition), and the maintenance cost (in spare parts, number and training of mechanics, etc.). A little study on the part of the reader will indicate that standardization of major components, particularly those with high mortality rates, coupled with weight reduction of the tank whenever possible will lead to lowered total military costs and at the same time will keep our tanks rolling along in battle.

Must Be Cheaper

In consonance with this line of thinking, a newly developed component is normally not entered into the Ordnance production system until it is reasonably certain that it is cheaper in total military cost than the item presently in use and is worthy of being standardized in an appreciable number of vehicles.

Army Ordnance has never forgotten the costly headaches which resulted from using four different types of improvised engines in just one class of tanks—the medium tanks of World War II. Continental R975 radial air-cooled engines, GM Diesels, Ford GAA gas engines, and Chrysler "multibanks" (five engines coupled together) were used to power just our medium tanks.

Over 4,000 spare parts, 4 sets of repair tools and maintenance literature, and a constant flow of engineering modifications were introduced into the logistic channel for these engines alone. The effect on the troops who used such nonstandard tanks in armored divisions was not difficult to imagine, nor was the effect on the taxpayers—who include Army officers, incidentally.

Engines Interchangeable

Since World War II, Army Ordnance has been able to develop a family of standard air-cooled tank engines, and hydraulic transmissions as well, that can be used in many different military vehicles. The same air-cooled engine that is used in the Walker Bulldog tank is also used in seven other vehicles. The same power plant that is used in the Patton 48 is used in at least five other combat vehicles.

This standardization of components is saving money in development, testing, and production and is drastically reducing the number of spare parts needed in the pipeline and in the various echelons of maintenance from the base rebuild factory to the tank maintenance crew itself. It also has reduced the number of engines on which mechanics must be trained and thus reduced training time as well as school and administrative staffs.

At the same time these compact components can lead to smaller, lighter vehicles which consume less gasoline and oil. In a nutshell, this and other standardization efforts by Army Ordnance permit more soldiers on the front line and fewer in the rear—and save the taxpayer money.

Although standardization and total military cost are important in any tank program they are meaningless unless the end product is also effective. Without fear of valid contradiction, it can be flatly stated that our present family of tanks is effective—they are the best tanks that we know of in the world today.

The Walker Bulldog (M41) light tank, produced by the Cadillac Division of General Motors, is at least a match for the heavier Russian T34 medium tank. It can easily outmaneuver and outshoot the T34. As the troops say, "We really love that gun on the 41." Its present cost, fully equipped and ready to fight, is approximately $87,000. This price, and other prices quoted below, does not include the cost of a stock of spare parts which are usually purchased concurrently for future maintenance and rebuild use. This price is "in line" when one considers the qualitative superiority of the Walker Bulldog over the World War II Chaffee M24—twice the horsepower, a much more powerful gun, and appreciably better armor protection, to mention a few points. The M24 today would cost at least $70,000.

The Patton 48, designed by Chrysler and produced by Chrysler, Ford, and General Motors Corporation is without a doubt the best medium tank known in the world today. Armed with a high-velocity 90-mm. gun and caliber .50 and .30 machine guns, its 49 tons are covered with sloping, elliptical armor plate which is extremely difficult for enemy shells to "bite."

Can Defeat Soviet Tanks

The Patton 48 medium tank can, of course, easily handle the Russian T34 medium tank. The important thing, though, is that it will undoubtedly be able to handle the successor to the T34. Right now the Patton could give a good account of itself against the vaunted Russian JSIII heavy tank.

The present price of the Patton 48, ready to fight, is approximately $160,000. There is every reason to believe that it will soon be down to the present price of the Patton 47—$129,000. By way of comparison, the World War II M26 Pershing medium tank (underpowered, by present-day standards) would, today, cost approximately $140,000.

The T43 heavy tank, armed with a high-velocity 120-mm. gun, designed and produced by Chrysler, is America's slugger tank—a slugger which can knock out the Russian JSIII—and its successor—with relative immunity. Further details on the performance of this tank cannot be given for obvious security reasons.

Are in Production

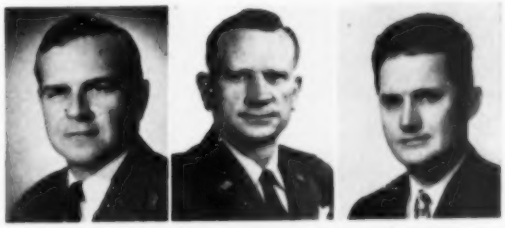
These, then—the light Walker Bulldog, the medium Patton 48, and the heavy T43—are the triumverate of America's family of modern tanks. And they not only exist on paper, but actually are being produced. The Ordnance policy of using standardized components whenever possible has permitted mass production in industry which in turn has led to lower prices than were obtained in World War II.

It would be folly to assume that these tanks, good as they may be, will be ideal for years to come. For that reason the Ordnance-Industry research and development team is working daily on short-term modification plans and long-term pilot model designs. If enemy tanks can be made obsolete, we aim to be the boys who do it!

Chairmen of A.O.A. Technical Divisions and Committees

The Technical Divisions and Committees are advisory groups organized primarily along commodity lines to serve the ordnance organizations of the Army, Navy, and Air Force in a consulting capacity. Photographs of the other chairmen appeared in the May-June issue of ORDNANCE.

GAGE INDUSTRY DIVISION



Louis Polk
Chairman, Gage Industry Division

Col. J. G. Schneider
Deputy Chairman, Gage Industry Division

M. L. Fruechtenicht
Secretary, Gage Industry Division

ROCKET, BOMB AND ARTILLERY AMMUNITION DIVISION

R. L. Telford
Chairman, Rocket, Bomb and Artillery Ammunition Division

W. N. Howley
Deputy Division Chairman and Chairman, Shell Committee

N. L. Etten
Chairman, Bomb Committee

K. T. Norris
Chairman, Cartridge Case Committee

J. F. Griswold, Jr.
Chairman, Container Committee

J. D. Dickerson
Chairman, Ferrous Metallurgical Committee

J. E. Burke
Chairman, Fuze Committee

J. G. Pleasants
Chairman, Loading Committee

C. H. Carter, Jr.
Cochairman, Powder and Explosives Committee

F. M. Hakenjos
Cochairman, Powder and Explosives Committee

C. L. Eksergian
Chairman, Rocket Committee

Howard L. Miller
Chairman, Development and Material Subcommittee, Rocket Committee

J. S. Gillespie
Chairman, Carbide Cutting Tool Subcommittee, Shell Committee

F. E. Shumann
Chairman, Casting Subcommittee, Shell Committee

C. L. Kent
Chairman, Cold Finish Bar Subcommittee, Shell Committee

L. A. Ward
Chairman, Nonferrous Metallurgical Advisory Committee on Ammunition Components, Shell Committee

H. M. Heyn
Chairman, Heating and Heat Treating Furnace Subcommittee, Shell Committee

A. J. Langhammer
Chairman, Powder Metallurgy Subcommittee, Shell Committee

F. J. DeWitt
Chairman, Surface Preservation Subcommittee, Shell Committee

Dr. Albert Muller
Chairman, Welding Subcommittee, Shell Committee

Industrial Mobilization Planning

"Modern war is not Merely a conflict between opposing groups of armed men, but between rival industrial systems. . . It is but the cutting edge of a militarized industrial system."

TWO recent statements by official advisers have sounded warnings for America which ought to ring out like Jefferson's "fire bell in the night." Taken together, they go to the heart of our problem of military-industrial preparedness.

Twenty Years Ahead

One was the sober counsel of retiring foreign aid administrator, W. Averell Harriman. In a farewell interview last January he warned the new Administration to look ahead twenty years in its military industrial planning if it expects to keep pace with the growth of Soviet power.

Since 1940, he declared, Russia has enormously expanded its productive power, and the bulk of the increase has gone into armaments or heavy industry.

The second statement was the report of the Vance Committee, headed by Harold S. Vance, president of the Studebaker Corporation. "The outbreak of a new war," the committee observed, "probably will not allow this country the necessary period of time in which to expand its production equipment industries and tool up its military production plants, such as it enjoyed in the First and Second World Wars."

Reserve Facilities

In the committee's view, our military-production planning must include maintenance of stockpiles of machine tools and stand-by munitions plants fully ready to go into war production at any time.

Both these reports are pointed toward the future, which we can but dimly foresee. Both also suggest that we take a look at the past, about which we know much more.

What does our experience with military procurement planning in the past indicate for the present?

Volumes have been written about this question, and other volumes are still being worked on by historians both in and out of the Government. But enough facts are available to give some tentative answers.

It took the first World War of 1917-1918 to show America the high cost of industrial unpreparedness for war. That conflict caught us woefully unprepared for the speedy production of guns and ammunition. For most items of military equipment our troops overseas had to depend on France and Britain.

It took the second World War of 1941-1945 to show that even a modest amount of advance planning for military procurement pays big dividends. Because of the thought given in peacetime to the best way of managing war procurement, the armed services were far better prepared on the supply front in 1940-1941 than they had been twenty-three years before.

There is much talk—among businessmen, military people, and historians—about how the War Department's prewar procurement plans were junked when war came in 1941. There is even the implication that war is such an unpredictable thing that there is no use even trying to plan for it.

Planning Paid Off

Every one agrees that in the early stages of World War II very few things went smoothly or according to plan. There were extremely rough spots along the procurement road, and some plans were junked as worthless even before war came. But the small investment made during the years of peace in procurement planning nevertheless paid

Pays Off

by DR. HARRY C. THOMSON

Army photo

big dividends in time, in money, and in lives saved.

The experience of the Ordnance Corps is most instructive on this point. It may be studied as a case history of military procurement planning at the supply-service level.

Basic Elements

The basic elements in the Ordnance plans of the 1920's and 1930's may be briefly summarized as follows:

1. Maintenance of six Government-owned arsenals at which small quantities of noncommercial items were produced. The functions of the arsenals were to keep alive the art of munitions making and to develop efficient methods of mass production to be used by private industry in time of war.

2. Maintenance of district offices covering every important manufacturing center in the United States. The functions of these offices were to survey industries suitable for producing war matériel, to enlist the support of leading industrialists in preparing war production plans, and to serve as nuclei around which full-scale procurement offices would grow in time of war.

Dr. Thomson is chief of the Historical Branch, Office of the Chief of Ordnance, Washington, D.C.

3. Preparation, in close teamwork with private industry, of plans for new plants to produce ammunition. In 1937 a suboffice was set up in Wilmington, Del., to work with engineers from industry to design ammunition plants. By 1940 the Ordnance Department had plans ready to meet the emergency.

4. Through educational orders, which the War Department and the Ordnance Association had repeatedly urged for many years, a start was made just before war came to help industry prepare for its wartime rôle in producing hard-to-manufacture items.

Gages Stockpiled

5. Because of the critical shortage of gages which developed during the first World War, Ordnance stockpiled gages in large numbers after the 1918 armistice. It established gage laboratories in the 1930's and at the start of the defense period in 1940 launched a program of gage procurement far in advance of the need. Efforts were also made to acquire stockpiles of machine tools at the arsenals, but in relation to the need the funds available were only a drop in the bucket.

Over-all direction of Army procurement plans was centered in the Planning Branch of the Assistant Secretary of War's office. During the 1930's this branch was headed by an Ordnance officer, Col. (later Maj. Gen.) Charles T. Harris, who brought to the task a rare combination of practical experience, imagination, and unwavering devotion to the cause of military-industrial preparedness.

Fortunate Circumstance

In 1938, General Harris became chief of the Ordnance Industrial Service and for the next four years directed the application of the procurement plans he had helped to formulate. It was largely due to this fortunate circumstance that Ordnance procurement plans achieved a large measure of success.

When war broke in December 1941, General Harris' associates found that he was one of the calmest men in Washington. "There were a lot of jitterbugs in those days," he recalled recently. "And some of them were in high places. But we in Ordnance were confident that we had laid a solid foundation for a successful war production program."

Rôle of the Arsenals

At the start of the emergency period, 1939-1941, the arsenals came into their own as the "Regular Army of Production." Before private industry was able to get into arms-making on a big scale, the arsenals filled the gap by turning out a wide variety of guns and ammunition. Springfield, for example, was the main source of the Garand rifle, and Frankford produced the great bulk of small-arms ammunition before Pearl Harbor.

The arsenals further proved their worth by helping industry make Ordnance items. Their policy was not to dictate but simply to make available the experience they had accumulated over the years. At the same time they provided specifications and drawings and in some cases were able to show model production lines in operation.

Equipment Antiquated

The big hitch was that, because of lack of funds, most buildings and machinery at the arsenals were antiquated. In 1939 some eighty per cent of the machine tools at the arsenals were eighteen or more years old, and a few antedated the Spanish-American War.

Some new equipment was installed in the late 1930's, but not enough to keep fully abreast of the latest manufacturing techniques.

Even more important than the arsenals, as far as quantity procurement went, were the Ordnance district offices and their procurement plans. Each headed by a prominent industrialist aided by an Ordnance officer, these offices formed essential links between industry and the Army.

They administered the educational orders, arranged for production studies, collected data on industries suitable for conversion to war production, and kept alive the spirit of procurement planning

As early as August 1940, fifteen months before Pearl Harbor, the district offices were "activated." They grew with great speed and soon became full-fledged procurement offices, each handling contracts for hundreds of millions of dollars a year. They decentralized Ordnance procurement and kept it where it belonged—close to industry.

Many Difficulties

The expansion did not occur without difficulty. Finding competent personnel in the fall of 1940 was not easy. For many months, all contracts had to be sent to Washington for final approval. Managing negotiations with business firms which had never before made munitions under Government contract required patience, tact, and skill on the part of district personnel.

But the problem would have been doubly great without the preparatory work done prior to 1940, limited though that work was.

The districts, even more than the arsenals, were starved between the wars. In the 1930's you could count the staff of a typical office on the fingers of one hand. The annual budgets were picayune in comparison with later years. But their speedy response to the pressure of war in 1941-1942 proved their value beyond question.

Plans for building new ammunition plants were dictated by the nature of the commodity. Unlike some European countries, the United States has never had a powerful privately owned munitions industry. Nor did it have private plants which could be readily converted to mass-production of military ammunition.

Only Ammunition Source

Aside from small-scale production at a few private plants, Frankford Arsenal was in 1940 the only source of a wide range of military ammunition. When the defense program was launched in that year, new plants for loading ammunition and producing smokeless powder, TNT, and ammonia had to be built from the ground up.

They were constructed in accordance with prepared plans and in less than eighteen months were turning out immense quantities of ammunition of many types.

Stockpiling gages and machine tools was not as easy as it sounds. It cost a great deal of money both for initial purchase and for maintenance in storage. And such equipment sometimes became obsolete in the face of changes in weapons design or manufacturing techniques.

Before World War II, Ordnance had enough funds to set aside only a few items, mostly gages and machine tools, for the proverbial rainy day. The gage-preservation program, supplemented by early expansion of gage production, was eminently successful.

But there was never enough money to stockpile large numbers of machine tools.

And before 1940, who could have foreseen the President's program for creating a two-ocean Navy, upping aircraft production to the rate of 100,000 a year, and procuring huge quantities of tanks, machine guns, and ammunition to supply other nations as well as our own expanding Army?

Machine-Tool Shortage

The machine-tool shortage was one of the earliest and most persistent bottlenecks in the Ordnance program during World War II. Because the Navy and Air Force had top priority, Ordnance never had enough tools to meet its needs.

If any aspect of World War II mobilization may be termed a failure, it was, from the Ordnance viewpoint, the machine-tool shortage. Granted that no amount of prewar preparation would have eliminated the problem altogether, more attention to the production-equipment industry prior to 1940 would have helped greatly.

The War Department's educational-orders program in 1939-1940 was largely an Ordnance show. Designed to enable industry to learn by doing and to acquire essential manufacturing devices, the program called for small-quantity production of hard-to-manufacture items.

In many instances, such as with the new M1 rifle, they were highly successful. But the educational orders were started too late to realize their full usefulness.

Lessons Not Forgotten

It is important to note that at the end of World War II the lessons of that conflict were not forgotten by the Army. They were preserved in the minds of experienced officers and civilians and in countless volumes of historical reports and correspondence files. More important, they were applied by the technical services in making their postwar mobilization plans.

The Ordnance Corps maintained its arsenals and district offices after V-J Day. Production equipment, such as machine tools and gages, was preserved along with fighting equipment such as rifles and tanks. Ammunition plants were kept in stand-by condition. Close liaison with industry was fostered through production studies and educational orders and the work of the American Ordnance Association.

It was a repetition of the earlier history, with modern refinements and on a larger scale than ever before.

No one then knew how soon this kind of industrial preparedness planning would pay off. But when the decision to send troops to Korea and to undertake a vast mobilization program was taken in 1950, Ordnance was prepared to act swiftly and efficiently.

How Much Preparedness?

The soundness of the principles of procurement planning within the Ordnance Corps in the past is scarcely open to question. The only real question before us today is, "How much industrial preparedness do we need to survive?"

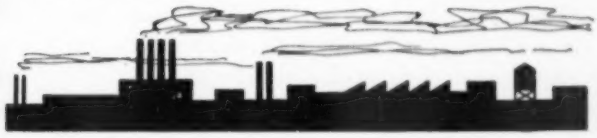
When that question is answered, in terms of complex political, economic, and social factors, there should be no difficulty in mapping out a program to achieve the desired goal in terms of our past experience.

Modern war is not merely a conflict between opposing groups of armed men, but between rival industrial systems. An army today, as one observer has put it, is but "the cutting edge of a militarized industrial system."

Reg. U. S. Pat. Off.

INDUSTRIAL PREPAREDNESS

a monthly report on current scientific and logistical developments as they relate to the national defense



AMERICAN ORDNANCE ASSOCIATION • *Founded in 1919* • 705 MILLS BUILDING, WASHINGTON, D. C.

No. 81 July 1953

● **Each year** a special committee of the national Executive Committee of the American Ordnance Association, under the chairmanship of the vice-president in charge of technical activities, reviews current programs of the Association's Technical Divisions and Committees and prepares a statement of policies and procedures.

The following statement was approved by the Executive Committee on April 22, 1953, and is published below for the information and guidance of all concerned.

POLICIES AND PROCEDURES NATIONAL TECHNICAL DIVISIONS AND COMMITTEES AMERICAN ORDNANCE ASSOCIATION

As directed by the Executive Committee of the American Ordnance Association, your Special Committee has prepared this brief review of the principal policies and operating procedures of the national Technical Divisions and Committees under the supervision of the proper vice-president. He shall see that the Divisions and Committees are administered in accordance with the policies of the Association and be assisted by a general chairman appointed by him, all to be confirmed by the Board of Directors.

Divisions are organized primarily along commodity lines and comprise such general and special committees as may be required adequately to perform their functions. It is their general purpose to assist ordnance production in every legitimate, ethical way, including redesign for maximum manufacturing efficiency, always keeping in mind field needs and other related problems.

Strictly voluntary patriotic services of qualified experts are made available in an advisory capacity and in a methodical, orderly fashion on technical, production-engineering, and other national problems affecting the common defense, at the request of the services involved (A.O.A. Constitution, Article III, Section 1, Paragraph (d), and as outlined in its By-Laws, *viz.*):

"To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects and to encourage programs for the adequate understanding of the procurement, production, and other related phases of national preparedness including those new developments of logistics necessitated by modern military strategy and tactics (By-Laws, Paragraph (d)).

"To promote mutual understanding and to effect coöperation with American scientists, inventors, engineers, and manufacturers in civil life and the personnel of the armed forces (Paragraph 1 (f)).

"To coöperate with all agencies of the Government in planning the mobilization and utilization of the Nation's scientific and industrial resources for the national security" (Paragraph 1 (g)).

Membership on these Committees shall be open to all qualified members of the Association. Of course there are practical limitations as to the total number of Committee and Division members at any one time so that it is entirely possible that all interested volunteers might not be placeable immediately.

The selection of Committee personnel, including

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subcommittees, shall be made by the Division or Committee chairman subject to the approval of the designated vice-president. It is recommended that Committees be kept at practical and workable size to function most effectively.

When subcommittees are appointed, they generally are limited to specific assignments and are terminated when their work is completed.

In furtherance of the above aims of the Association, the following policies and procedures have characterized the operations of the Technical Divisions and Committees since their organization and are firmly upheld in all their proceedings and activities:

1. With occasional exceptions dictated by intelligent, practical necessity, the Technical Committees are mainly concerned with end items and major components of ordnance and other armament, the general categories of which include:

All weapons and appurtenances for their operation and maintenance; all ammunition and its chemical, metallurgical, and atomic components; all rockets, bombs, guided missiles, torpedoes, depth charges, and mines; all combat vehicles, tanks, tank destroyers, and weapons carriers; all vehicles and aircraft for automotive and air transport of personnel, supplies, and matériel on and over land; all optical, aërial, mechanical, electrical, and electronic systems for locating and tracking targets on land, at sea, and in the air.

In its operations in these fields, the Association, as a matter of long-standing policy, does not trespass in those technical areas of ordnance logistics wherein other national technical societies are better equipped to serve the national interest.

2. Technical Committees are manned by qualified, volunteer representatives of American science, engineering, and industry who, by practical experience, are familiar with the problems of ordnance and armament manufacture. Service on A.O.A. Technical Committees is essentially a qualitative selection in order that the best engineering talent in the United States can be enlisted to assist the armed services in these fields. Committees are reviewed and revised from time to time to keep them currently most effective for requirements of the armed forces and to increase the number of qualified and experienced experts available for an emergency.

3. New Technical Divisions and Committees are established only when there is a definite need for their services and when there is no other better-qualified organization prepared to undertake the assignment.

4. Technical Committee members devote their efforts to the consideration of problems connected with production engineering, manufacturing techniques, and allied ordnance logistical or other supplementary subjects.

It is not within the scope of any A.O.A. Committees to discuss or to be at all concerned with individual matters of trade, procurement, price, market, or control nor with the placement of specific contracts among prospective producers, or to do anything whatsoever connected with the determination of particular prices of a complete article or the component materials or the allocation of materials among specific prospective producers.

5. In order to staff the Technical Committees with the best talent available, many of the most useful members are very busy and successful businessmen. Much of the technical work is undertaken by the exchange of mailed information and comment whenever possible.

Technical groups generally meet at least annually, unless specifically requested by an agency of the national-defense establishment to meet oftener for the review of technical progress and the consideration of current problems in the scientific and engineering field to which the Division is allied.

At all meetings the senior Government representative present, who presides, is responsible for checking security features, including the individual security clearances of all persons in attendance. He also assists with the program and in keeping full and complete minutes of the meeting.

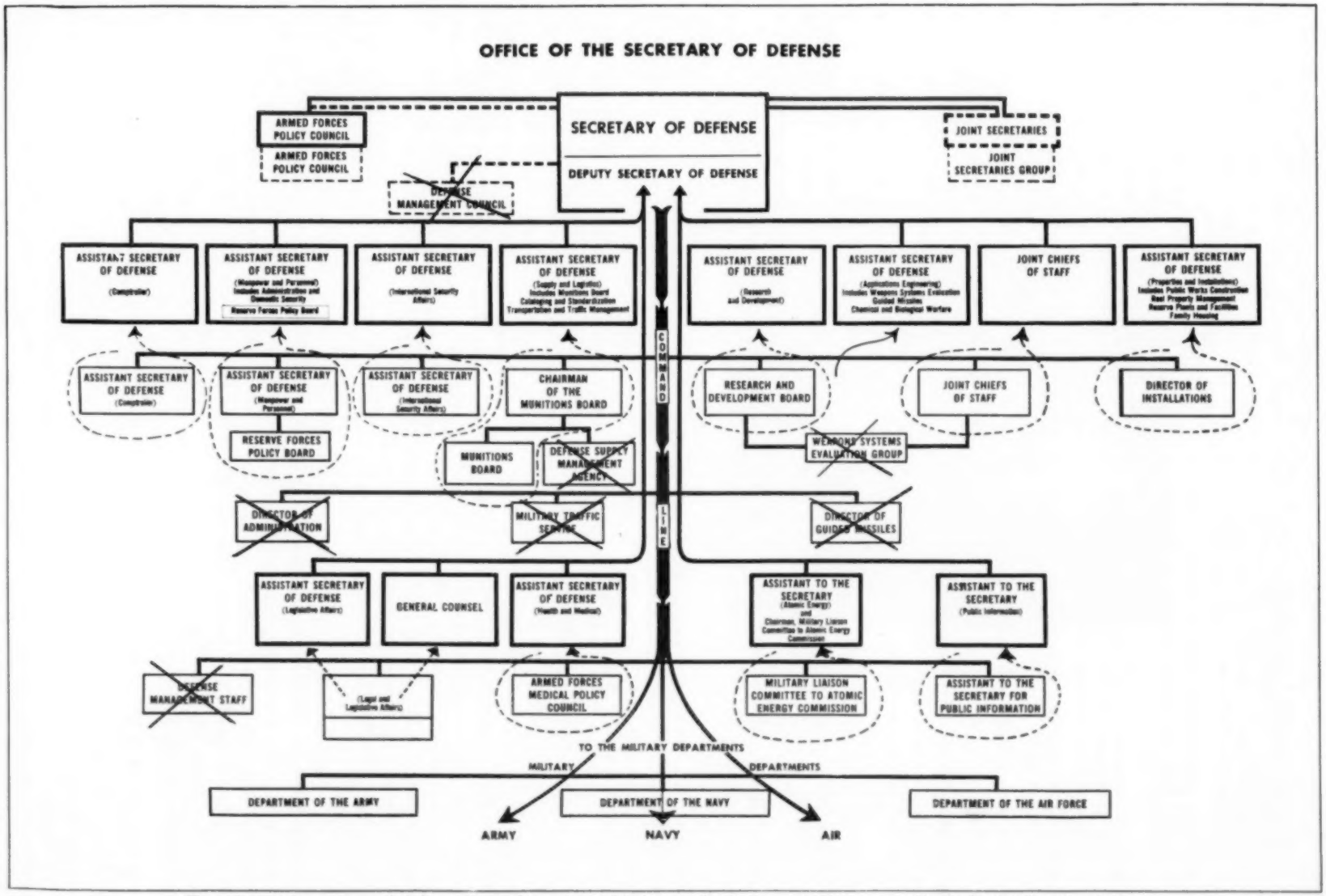
It is the responsibility of the Division or Committee chairman to furnish the senior Government representative with the list of persons who are invited to attend so that proper clearance may be obtained and to coöperate in keeping complete minutes of this meeting. The Division or Committee chairman conducts the technical sessions and is responsible for developing all phases of the problem under consideration.

The conclusions, findings, and recommendations on each matter brought before the meeting are, wherever possible, dictated in open meeting by the chairman to insure their approval by the Division or Committee and correct incorporation in the minutes.

The members of the Technical Divisions and Committees within the above policy framework offer their services and talents to assist our country in maintaining its freedom by a program of preparedness for national defense.

May 1, 1953 (*Signed*) Louis Polk, *Chairman*

Vice-President, American Ordnance Association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ARMED FORCES POLICY COUNCIL
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JOINT SECRETARIES
JOINT SECRETARIES GROUP
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ASSISTANT SECRETARY OF DEFENSE (International Security Affairs)
ASSISTANT SECRETARY OF DEFENSE (Supply and Logistics) Includes Munitions Board Cataloging and Standardization Transportation and Traffic Management
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ASSISTANT SECRETARY OF DEFENSE (Applications Engineering) Includes Weapons Systems Evaluation Guided Missiles Chemical and Biological Warfare
JOINT CHIEFS OF STAFF
ASSISTANT SECRETARY OF DEFENSE (Properties and Installations) Includes Public Works Construction Real Property Management Reserve Plants and Facilities Family Housing
COMMAND
LINE
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ASSISTANT SECRETARY OF DEFENSE (Health and Medical)
ASSISTANT TO THE SECRETARY (Atomic Energy) and Chairman, Military Liaison Committee to Atomic Energy Commission
ASSISTANT TO THE SECRETARY (Public Information)
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TO THE MILITARY DEPARTMENTS
MILITARY DEPARTMENTS
DEPARTMENT OF THE ARMY
DEPARTMENT OF THE NAVY
DEPARTMENT OF THE AIR FORCE
ARMY
NAVY
AIR

Chart showing the recommended changes in the Department of Defense under the reorganization proposed by the Rockefeller Commission.

FUTURE SCHEDULED MEETINGS OF NATIONAL TECHNICAL DIVISIONS AND SPECIAL COMMITTEES OF THE AMERICAN ORDNANCE ASSOCIATION

- **Casting Subcommittee, Shell Committee of the Rocket, Bomb and Artillery Ammunition Division, September 1953.**
- **Rocket Committee of the Rocket, Bomb and Artillery Ammunition Division at Redstone Arsenal, Huntsville, Ala., November 5-6, 1953.**
- **Metal Lubricants Committee at Cincinnati, Ohio, November 1953.**

● **Secretary of the Air Force Harold E. Talbott** has assigned responsibilities, subject to his own direction and control, among his assistants as follows:

James H. Douglas, Under Secretary.—Over-all direction, guidance, and supervision of the affairs of the Air Force and its plans, policies, and programs.

H. Lee White, Assistant Secretary for Management.—Direction, guidance, and supervision over all matters in the fields of manpower, military and civilian personnel, Reserve components, training, management-improvement program, budgetary and accounting matters, participation in civil-defense activities, and the loyalty-security program.

Roger Lewis, Assistant Secretary for Matériel.—Direction, guidance, and supervision over all matters in the fields of industrial resources, industrial security and mobilization; procurement, production, storage, maintenance, distribution and disposal of all matériel, supplies, and equipment; participation in the Mutual Security Assistance Program; transportation and communications; renegotiation affairs, contract appeals, and related activities; and relations with civil aviation.

Trevor Gardner, Special Assistant for Research and Development.—Direction, guidance, and supervision over basic and applied research, development, determination of qualitative requirements, and continual integration of technology with military requirements and procurement planning.

A Special Assistant for Installations.—Direction, guidance, and supervision over all matters regarding installations planning and programming, acquisition and disposal of real estate, assistance in international negotiations on bases and facilities, construction of bases and facilities, and family housing.

● **John C. Garand,** widely known inventor of the Army's famed M1 rifle, retired recently at the Ordnance Corps' Springfield Armory in Massachusetts after thirty-four years of distinguished civilian service with the Army.

Garand is a name known to millions of American fighting men, as well as soldiers of many other nations, who have used the caliber .30 M1 rifle both in combat and training. More than four million Garand rifles have been manufactured since the Army adopted the design in 1936. Over 85 per cent of them were made at the Springfield Armory.

As a tribute to Mr. Garand for his "many contributions to the science of small-arms design and development," Secretary of the Army Robert T. Stevens authorized presentation to him of the one-millionth Garand rifle.

Presentation of the rifle bearing serial number 1,000,000 and the reading of Secretary Stevens' commendation was made by Maj. Gen. Emerson L. Cummings, Chief of the Industrial Division, Office of the Chief of Ordnance, Washington, D.C., at brief ceremonies in Springfield.

John C. Garand was born in 1888 in the Province of Quebec, Canada. At the age of ten he moved with his parents to Connecticut where he gained knowledge of guns by assisting an older brother with a shooting gallery. From 1908 to 1914 he was a tool and gage maker for Brown & Sharpe Manufacturing Company, Providence, R.I. Later he became a foreman and machine designer for the Federal Screw Corporation, also in Providence.

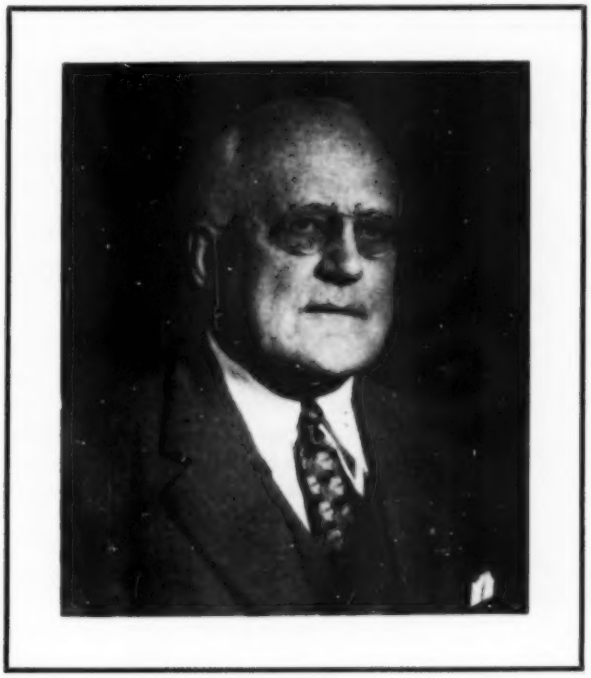
Mr. Garand became interested in the publicity given tests of machine guns early in World War I and, because of the frequent mention of malfunctions, decided that a machine designer should tackle this problem.

He worked out his own design of a light machine gun and presented it to the Naval Invention Bureau which in turn referred him to the National Bureau of Standards. There the design of the gun, which had many unique features, was completed. He remained with the Bureau of Standards until 1919 and then went to work at the Springfield Armory where he remained until his retirement.

During the succeeding years, Mr. Garand's design of a rifle was in competition with those submitted by a number of other noted designers. These were all caliber .276. Ultimately a decision was made against use of that caliber, and his caliber .30 rifle was adopted by the Army in 1936.

The American Ordnance Association joins his many friends in wishing him long life and much happiness.

Henry Parsons Erwin



The American Ordnance Association announces with profound sorrow the death of its distinguished treasurer, Col. Henry Parsons Erwin, at Washington, D.C., on June 3, 1953.

HENRY PARSONS ERWIN, one of the founders of the American Ordnance Association and treasurer of the society since 1945, died at his home, Arbremont, Washington, D.C., on June 3, 1953, after a long illness.

Widely known in national-defense and educational circles, Colonel Erwin was a leader in civic affairs. Born in Newark, N.J., he was graduated from the University of Michigan and the Illinois Institute of Technology.

During World War I he served as a captain in the office of the Chief of Army Ordnance in Washington and later commanded the Ordnance Depot at Paterson, N.J. In the Second World War he was a lieutenant colonel in the Ordnance Department and afterward was a member of the United States Honorary Reserve.

It was in 1919, following the First World War, that Colonel Erwin, in company with the late Col. James L. Walsh and a few other Ordnance stalwarts, founded the American Ordnance Association to help foster industrial preparedness for the peace and security of the United States. Long a director and officer of the A.O.A., his untiring zeal and devotion to the cause of peace were formally recognized by the award of the Association's Crowell Medal and honorary life membership on October 2, 1946.

An engineer and manufacturer in his early career, Colonel Erwin was later a director of the Riggs National Bank and the Federal Storage Company. He was secretary of the board of trustees and chairman of the finance committee of George Washington University which recently conferred upon him the honorary degree of doctor of science.

Well known for his philanthropic and charitable activities, Colonel Erwin was treasurer of both the Boys' Club Foundation and the National Capital Area Council of the Boy Scouts of America and a member of the Region III executive committee. He was also first vice-president of the Barney Neighborhood House for underprivileged children in Washington.

Colonel Erwin was a member of the Community Chest Federation classification committee and vice-president of the Washington United Services Organization.

Officer, philanthropist, financier, and engineer, Colonel Erwin combined love for country and regard for his fellow man to a degree that made him an outstanding American. His loss to the American Ordnance Association and to the Nation is very great, and his memory will long be cherished by all members of the Ordnance fraternity.

Month by Month: Highlights of the National Defense

Reorganization Plan No. 6

In his April 30th address to the Congress, calling for a reorganization of the Department of Defense, President Eisenhower had this to say:

"I address the Congress on a subject which has been of primary interest to me throughout all the years of my adult life—the defense of our country.

> *"As a former soldier who has experienced modern war at first hand, and now, as President and Commander in Chief of the Armed Forces of the United States, I believe that our Defense Establishment is in need of immediate improvement. In this message, I indicate actions which we are taking, and must yet take, to assure the greater safety of America."*

General Eisenhower outlined the following three objectives in organizing our defense:

1. Our military establishment must be founded upon our basic constitutional principles and traditions. There must be a clear and unchallenged civilian responsibility in the Defense Establishment. This is essential not only to maintain democratic institutions, but also to protect the integrity of the military profession.

> *Basic decisions relating to the military forces must be made by politically accountable civilian officials. Conversely, professional military leaders must not be thrust into the political arena to become the prey of partisan politics.*

To guard these principles we must recognize and respect the clear lines of responsibility and authority which run from the President, through the Secretary of Defense and the Secretaries of the military departments, over the operations of all branches of the Department of Defense.

2. Effectiveness with economy must be made the watchwords of our defense effort. To maintain an adequate national defense for the indefinite future we have found it necessary to devote a larger share of our national resources than any of us have heretofore anticipated. To protect our economy, maximum effectiveness at minimum cost is essential.

3. We must develop the best possible military plans. These plans must be sound guides to action in case of war. They must incorporate the most competent and considered thinking from every point of view—military, scientific, industrial, and economic.

Much has happened since Congress passed the National Security Act of 1947 and strengthened it in 1949. Valuable lessons have been learned by experience. Military action in Korea, the build-up of our armed forces, military aid to friendly nations, participation in the North Atlantic Treaty Organization—all these have supplied sharp tests of our military organization and indicated possible areas of improvement.

> *The President's reorganization plan transfers the functions of the Munitions Board, the Research and Development Board, the Defense Supply Management Agency, and the Director of Installations to Defense Secretary Wilson. The plan also calls for the creation of six new Assistant Secretaries of Defense and sets up a General Counsel's office.*

These proposed changes do not affect the structure of the National Security Act and are intended to achieve increased effectiveness at low cost.

Keynote of Preparedness

Secretary of Defense Charles E. Wilson, in acknowledging receipt of the American Ordnance Association's report on Reserve Ordnance Production Capacity (see page 46 of this issue), stated to Lieut. Gen. L. H. Campbell, Jr., president of the Association, "I am anxious to take steps as soon as possible to see that these recommendations are integrated into our mobilization policies."

Such assurance from Secretary Wilson is most gratifying to the members of the Association, and it is indeed fitting that he should at this time be in a position to inaugurate this action for the national defense. For it was at the Thirty-third Annnal Meeting of the American Ordnance Association held in Cincinnati, Ohio, on October 4, 1951, that Secretary Wilson, as the principal speaker on that occasion, first sounded the keynote for reserve capacity in American industry to insure early ordnance production for this country in case of threatened or actual war emergency.

> *Secretary Wilson, with his long experience in industrial production in peace and war, saw clearly, even then, that in the unsettled international complications of the present era our defense facilities could not swing, pendulumlike, from one extreme to the other without grave threat to either our security or our solvency.*

In this great address at Cincinnati, in the fall of 1951, Secretary Wilson said:

"If we are to face the realities and not take another chance on being caught 'too late with too little,' we must learn from present experience and reverse our prewar concept as to the importance of military preparedness.

"After the war, if we are to win the peace, we must continue to move forward by maintaining for preparedness equally close liaison between the armed services and industry. This calls for unceasing application of the day-to-day developments of science and industry to the improvement of war material and methods of manufacture, so that American industry shall ever be ready to set in motion quickly, if needed, its vast powers of mass produc-

tion for war *with minimum changes in plant and machinery.*"

Recognizing Mr. Wilson as a champion of industrial preparedness for national defense, the Cincinnati Post of the Association on that occasion bestowed upon him the Charles L. Harrison Medal for Distinguished Ordnance Service with this citation:

"Industrial leadership is a priceless American heritage. Such leadership when applied to the national defense of our country is beyond appraisal. Under Mr. Wilson's direction, General Motors Corporation, during World War II, produced armament on a scale of volume and diversity never before known in the history of our country. Not only in the great volume of production, but in many other phases, such as the training of our manpower in the operation and maintenance of military equipment, his leadership served the Nation well.

"To you, Charles Erwin Wilson, for your knowledge of design and your contribution to production methods of ordnance and matériel for the armed forces; for your determination and resourcefulness in overcoming difficulties in war production; for your leadership in undertaking a great share of the defense production load of the Nation; for your unfailing faith and striving to strengthen the national effort; for service which is indeed distinguished we have the honor to present the Charles L. Harrison Medal, the Distinguished Service Award of the Cincinnati Post, American Ordnance Association."

With Secretary Wilson's experienced leadership our country may look forward with confidence to a period of sound industrial preparedness and attainment of the long-sought goal of "Peace through Strength."

Baruch on Controls

Appearing before the Senate Banking and Currency Committee, Bernard M. Baruch again uttered an eloquent plea—the same sort of appeal he has been making for thirty-five years—to place wartime economic controls on the statute books *now* so that they could be invoked without delay at some future time of peril.

"You face a simple issue," he said. "Are we to take the elementary precaution of writing into law now what we know would have to be done in event of emergency? Or shall we neglect this vital measure of defense and, in doing so, increase the risk of war, add to the toll of dead and wounded if war does come, and make inflation certain—all needlessly?"

> *Mr. Baruch predicted that the next war is likely to explode all in a big smash. If stand-by legislation is not enacted and the day of the big smash does come, he declared, there will not be a person alive who will not bitterly rue this tragic, needless neglect.*

"To wait," he said, "is to die. To wait is to make certain our mobilization will be needlessly slowed, which means lengthening the struggle for victory and dooming some to lose their lives—needlessly. To wait is also to make certain that there will be some degree of cruel inflation—again needlessly."

Artillery Ammunition

In his testimony before the Senate Subcommittee on Ammunition Shortages—the complete account will be found on page 47 of this issue—Maj. Gen. E. L. Ford, Chief of Ordnance of the Army, pointed out that in every war, every military man and industrialist in the production field has had to contend with a general unwillingness to recognize the fact that complicated military items cannot be produced overnight by industry previously devoted to other types of manufacture.

General Ford emphasized the importance of lead time in its influence on production. This becomes apparent when it is realized that, during fiscal year 1951, over ninety per cent of the dollar value of ammunition orders placed went to contractors who required either new facilities, production equipment, or the rehabilitation and reactivation of Government-owned plants before commencing production. For 1952 the proportion was about sixty per cent.

> *A careful reading of General Ford's testimony would seem to indicate that the Army should adopt, without further delay, the three invariable practices of private industry in the field of production.*

This involves, first of all, giving the ordnance production job—lock, stock, and barrel—to a qualified and well-trained officer, aided by an adequate and experienced staff.

Secondly, private industry removes all shackles, political and departmental, from the production chief's hands.

Finally, private industry gives the production chief authority commensurate with his ability.

The superb Ordnance record of 140 years is the best proof of the Corps' ability to produce superior ammunition. But no Chief of Ordnance, however gifted, can produce quantity ammunition when weighted down with three heavy millstones—inadequate authority, insufficient time, and miles and miles and miles of red tape.

Low-Cost Producers

The time has come to evaluate future munitions production on the basis of cost. Today it would seem to be beyond argument that the low-cost producer of high-quality equipment is the Nation's best producing arsenal.

Such is the view of Wilfred J. McNeil, an Assistant Secretary of the Defense Department, who recently informed the Virginia State Chamber of Commerce that the Government will decrease the number of plants produc-

MATERIALS SAVINGS

The Navy estimates it is saving 2,109,000 pounds of aluminum, 6,790,000 pounds of copper, 1,408,000 pounds of chromium, and significant quantities of other strategic and critical materials as a result of conservation measures adopted during 1952.

The savings are being made by the Bureau of Ships, Bureau of Aëronautics, Bureau of Medicine and Surgery, and the Bureau of Yards and Docks. They are being achieved by substituting less critical materials and by eliminating or reducing the need for critical materials in military equipment.

ing weapons and other munitions as defense goals are met.

> *Mr. McNeil said that the plants to be weeded out of defense production will be the "less efficient, high-cost producers whose productive capacity was temporarily required during the initial build-up stages.*

He denied that this policy represents a return to the hasty and excessive demobilization that followed World War II.

In a similar address before the U. S. Chamber of Commerce, Deputy Defense Secretary Roger M. Kyes listed six principles which the Defense Department will employ in deciding what firms will be granted future military contracts:

1. The organization should have the management and technical knowledge required efficiently and successfully to accomplish the production task to be assigned.

2. The selected company must have available facilities and equipment to expand its capacity to the level required by the Defense Department.

3. The company should be sufficiently well financed so that it will need only to supplement its capital and should not expect to rely completely on the various forms of Government assistance.

4. There must be a sufficient reservoir of manpower with the skills needed for efficient production.

5. Based on the nature of the equipment to be produced, no facility should be established which falls below the requirement of a minimum economic production unit.

6. An organization should not be given more defense business than it can handle efficiently.

Vice-Presidents of Defense

The long-awaited Rockefeller Committee report on the organization of the Department of Defense recommends the establishment of additional Assistant Secretary positions, believing that it will be possible to obtain better results with a substantial number of employees.

> *The Committee urges the retention of the three present Assistant Secretaries of Defense who deal with fiscal matters, international security affairs, and manpower and personnel.*

The following six positions would be authorized:

1. An Assistant Secretary for Research and Development. This would involve the dissolution of the present Research and Development Board and would make it possible to establish a more flexible organization.

2. An Assistant Secretary for Applications Engineering. This official would concentrate attention on the broad field which lies between research and development and the quantity production of weapons.

3. An Assistant Secretary for Supply and Logistics. This official would have responsibility for the formulation of over-all policy and for the supervision and review of programs in the fields of procurement, production planning, distribution, transportation, stockpiling, and warehousing.

4. An Assistant Secretary for Properties and Installations. This official would be responsible for reviewing the plans and construction of all public-works projects.

5. An Assistant Secretary for Legislative Affairs who would be responsible for the effective coördination of the legislative recommendations originating in the military departments before submission to Congress.

6. An Assistant Secretary—Health and Medical. He would provide and manage hospitals at the smallest possible cost in dollars and personnel.

Bureau of Standards

Since World War II, and particularly since the beginning of the Korean war, more than three-quarters of the National Bureau of Standards' staff has been working on problems for the Department of Defense. It has also rendered valuable services to other agencies of the Government.

> *Appreciable savings in Government procurement operations are possible through the intelligent use of technical purchase specifications and acceptance testing based on carefully planned laboratory investigations.*

The Industry-Ordnance Team is particularly indebted to the Bureau of Standards for assistance in many phases of Ordnance research and development. Dr. Allen V. Astin, a career scientist and now Director of the Bureau, had a large share in the development of proximity fuzes for bombs and rockets.

Dr. Astin and other Bureau scientists deserve the gratitude of all citizens because of their invaluable contributions to the cause of national security.

Heavy Press Program

The Air Force Heavy Press Program is being reviewed by the Department of Defense.

> *The maintenance of American leadership in design, development, and production of conventional and pilotless aircraft and rockets is in part predicated on the availability of the heavy forging and extrusion presses now under construction.*

The establishment of the new program resulted from the need for the development of larger capacity facilities to meet the requirements for stronger structural members of airframes and a more efficient method of production of numerous components for both airframes and engines.

Largest Motors

The most powerful electric motors known to have been built were installed recently at the Arnold Engineering Development Center of the Air Research and Development Command at Tullahoma, Tenn.

The 2 motors, rated at 83,000 horsepower each, and a smaller pair of 25,000 horsepower each, will be used to drive 5 compressors which will produce man-made hurricanes for the transsonic and supersonic wind tunnels of the Propulsion Wind Tunnel Facility at the center. When assembled in tandem fashion the entire machine, consisting of motors and compressors, will be approximately 500 feet (almost 2 football fields) in length.

Capacity for Defense

An Editorial

IN recent weeks President Eisenhower has indicated a shift in defense production policy from rapidly fluctuating peaks and declivities, starts and stops, to a long-term, efficient and economical plateau of alert preparedness. The new program calls for a steady and adequate flow of men and materials in order to present a position of genuine strength for the United States of America.

Our present and future policy, President Eisenhower asserted, "will not be tied to any magical critical year which then has to be 'stretched out' because of production or economic problems, but will be based on the sounder theory that a very real danger not only exists this year, but may continue to exist for years to come; that our strength, which is already very real, must now be made stronger, not by inefficient and expensive starts and stops, but by steady and continuous improvement."

It is necessary for us to be strong, continuously, and to become stronger. But a long-range program of adequate preparedness inevitably brings in its wake a danger to our own internal economy. We cannot be free, today and tomorrow, unless we are strong. And we cannot be strong, now and in the future, unless we avoid economic bankruptcy.

President Eisenhower has wisely emphasized the essential relationship that exists between security and solvency. He is firmly convinced that our national plateau of strength must lie within the frontiers of our economic means. He believes that with better management and administration it will be possible to reduce the defense budget by several billions.

Some reorganization within the Defense Department, a higher degree of civilian control, a better definition of function, more economy in operation—these are the current Eisenhower goals. He is seeking a more effective defense strength within budgetary limitations. In this vital field the adjustment of military capability to economic capability is probably the most important and the most complex problem confronting our Government today.

Blandy Board Report

The American Ordnance Association has always taken a constructive interest in national-defense problems and wholeheartedly concurs in the President's program of keeping America strong by keeping our production capacity ready for any emergency that may be thrust upon us at any time. The recommendations of the Association, prepared under the direction of Adm. W. H. P. Blandy, is firsthand proof of this. The Blandy Board report (published in full on p. 44) is convincing evidence of the Association's patriotic concern with the difficult problems that are directly related to our national security.

In addition to Admiral Blandy, the Board, appointed by the A.O.A. directors, is composed of the following members of the Association: Rodger J. Emmert, General Motors Corporation, Detroit; Howard E. Isham, United States Steel Corporation, New York; W. G. Lockwood, American Locomotive Company, Washington; and K. T. Norris, Norris-Thermador Corporation, Los Angeles.

The Blandy Board expressed the general view that required ordnance reserve production facilities be preserved to meet full mobilization-rate requirements and that they be maintained in an up-to-date condition ready for rapid activation in case of emergency. The Board also made five specific recommendations:

Specific Recommendations

1. With respect to present production facilities, where plant and production-line equipment are owned by the United States Government and are being operated by private organizations, that such reserve facilities be placed in standby in their present location under the care and surveillance of the private producer and that contracts for this purpose be entered into forthwith.

2. With respect to reserve production facilities, where plant is owned by a private producer and the production-line equipment is the property of the United States Government, that contracts be entered into immediately with the present producer for the location and surveillance of such equipment within or adjacent to the present plant.

3. With respect to special miscellaneous Government-owned machine tools now in the hands of manufacturers of components and which do not constitute complete production lines, that these should be classified as a national machine-tool reserve. They should preferably remain under the jurisdiction of the manufacturer in order that production know-how as to items not regularly produced commercially may be maintained at a maximum.

4. The improvement and development of weapons are a vital part of this program. Therefore, contracts for the engineering improvement of standard weapons should be entered into with private industry for the continual employment of its engineering personnel on the problem.

5. Periodic educational orders for limited production of important key items should become an established part of our national armament policy in order to develop more effective weapons, reduce the time required to attain initial production in case of an emergency, and to enable the using services to test and evaluate such new items in Army, Navy, and Air Force maneuvers.

The Blandy Board report directs realistic attention to the foundation on which the Eisenhower "plateau of defense" rests. It merits the immediate support of all our citizens in order that time, lives, and national wealth may be saved and victory assured in any future conflict.

ASSOCIATION AFFAIRS

Four New Association Vice-Presidents Elected by the Executive Committee

The Executive Committee of the American Ordnance Association met at Washington on Wednesday, April 22, 1953, to discuss and approve the Blandy Board Report on Reserve Ordnance Production Capacity. The meeting was held in the Cabinet Room of the Carlton Hotel.

John Slezak, a director of the Association and, at that date, Assistant Secretary of the Army designate, was welcomed by his fellow A.O.A. officials and received congratulations on his appointment. Lieut. Gen. Levin H. Campbell, Jr., president of the Association, presided at the meeting.

The following members of the Executive Committee were present: Harvey C. Knowles, Cincinnati, vice-president; Robert L. Biggers, Detroit, vice-president; Louis Polk, Dayton, vice-president; the late Henry P. Erwin, Washington, treasurer; Florence G. Ferriter, Washington, secretary; Leo A. Codd, Washington, executive vice-president; Henry N. Marsh, Wilmington, chairman, Technical Divisions and Committees; Burton O. Lewis, Washington, staff consultant for Technical Divisions and Committees.

The Blandy Board report was discussed in detail and approved unanimously. It is printed in full on page 44 of this issue. It was presented to the Secretary of Defense, the Hon. Charles E. Wilson, on May 1st by General Campbell. Copies have been sent to all officials of the Association and to the officers of Posts, Divisions, Committees, and to all company members.

Among the newly elected vice-presidents of the Association are, left to right, William J. Rushton, Charles M. White, and Myron J. Hayes.

The Executive Committee unanimously elected the following regional vice-presidents upon motion of General Campbell. They are:

Charles M. White, president, Republic Steel Corporation, Cleveland;

William J. Rushton, president, Protective Life Insurance Company, Birmingham;

Myron J. Hayes, vice-president, Eastman Kodak Company, Rochester;

W. G. Swartchild, Jr., Swartchild & Company, Chicago.

Following the consideration of reports and the transaction of routine business the committee adjourned at 3:00 p.m.

• **AT NEW YORK.**—The New York Post held a luncheon meeting in the Grand Ballroom of the Hotel Astor, New York City, on June 4th. Members were asked to bring their friends who might be interested in joining the American Ordnance Association.

Hon. John Slezak, Assistant Secretary of the Army, delivered the principal address. As a prominent industrialist and former Chief of the Chicago Ordnance District, Mr. Slezak is especially qualified to appreciate the problems of the manufacturer—as well as the Government—in maintaining a flow of ordnance material to the services.

There was an excellent attendance at the luncheon and Mr. Slezak's remarks were well received.

• **AT BOSTON.**—As part of the celebration of Armed Forces Week, the Yankee Post, in coöperation with the Hartford-Springfield Post, sponsored a New England Regional Meeting at Boston on May 8th.

The program began at 1:00 p.m. when more than 300 members and guests of the Association boarded a fleet of armed forces buses at the Sheraton-Plaza Hotel for a visit to the Jordan Marsh Company to inspect a very complete display of military equipment and to witness the operation of an intelligence defense center which simulated the tracking of enemy aircraft approaching vital targets in the United States.

The Ordnance delegation then boarded the buses for a trip to Watertown Arsenal where they were welcomed by Col. B. S. Mesick, the commanding officer, and inspected an outdoor display of some of the Army's most recent artillery weapons including the 75-mm. Skysweeper automatic antiaircraft cannon and the 280-mm. "atomic gun."

The A.O.A. members were also conducted through the Watertown Arsenal Laboratory where they saw the electronic microscope, radioactive-isotope laboratory, newest methods for plating titanium, and much modern research equipment.

The A.O.A. contingent was then whisked to the grounds of the Murphy General Hospital where Navy helicopters demonstrated the flying versatility of the rotor-winged aircraft and simulated a rescue operation by hoisting a sailor from the ground into a hovering helicopter.

The Ordnanceites then had a thrilling ride, under police escort, back through the Boston rush-hour traffic to the Sheraton-Plaza Hotel where a reception was held at 6:30 p.m. followed by dinner in the Grand Ballroom where nearly 700 members and guests gathered to hear the Hon. John F. Floberg, Assistant Secretary of the Navy for Air, who was the principal speaker. Secretary Floberg's address is published in full on page 34 of this issue.

Shown above at the New England Regional Meeting are, left to right: Brig. Gen. James F. McManmon, chairman, Armed Forces Week Committee; Hon. John F. Floberg, Assistant Secretary of the Navy for Air; and Rear Adm. John L. McCrea, Commandant of the First Naval District, Boston, who were among the guests of honor.

Brig. Gen. James F. McManmon, U.S.A.F.R., vice-president of Pilgrim Trust Company and chairman of the Armed Forces Week Committee of Boston, introduced Secretary Floberg.

Capt. George L. Markle, U.S.N., District Chaplain, First Naval District, gave the invocation, and Capt. Patrick J. Ahern, U.S.A.F., Base Chaplain, Grenier Air Force Base, Manchester, N. H., delivered the benediction. The United States Naval Base Band, Boston, furnished stirring airs during the dinner.

Harry A. Wansker, president of the Yankee Post, and his committee did an excellent and an efficient job in preparing and carrying out the many details connected with this very successful meeting.

Bethlehem Steel Company Plays Host to Philadelphia Post at Its Annual Meeting

Bethlehem Steel Company was host to the Philadelphia Post at its annual meeting on June 3rd when 450 members made a visit to the company's Bethlehem, Pa., plant.

Leaving Philadelphia by special train at 11:45 a.m., the members ate a box lunch en route and arrived at Bethlehem at 1 p.m. They then transferred to the company's observation train for a 3½-hour inspection tour which included the principal steel-making and manufacturing units. A highlight of the trip was the opportunity to witness the forging of a tube for the Army's new 280-mm. gun.

Upon completion of the tour, the visitors were taken to the Bethlehem Steel Club for cocktails and dinner. A business session followed the dinner.

Brief talks were made by J. M. Sylvester, general manager, who gave a description of the plant, and by George W. Struble, assistant to the vice-president, who dwelt on the plant's contribution to ordnance throughout its long history.

The principal address was given by Vice Adm. Arthur D. Struble, United States Naval Representative to the United Nations Military Staff Committee.

The return trip was made by special train, leaving Bethlehem at 8:45 p.m. and arriving in Philadelphia at 10:30 p.m.

• **AT SEATTLE.**—The May meeting of the Puget Sound Post was cosponsored by the Mechanical Engineering Department of the University of Washington and was held on the campus of that university.

The meeting featured an illustrated address by Dr. Wernher von Braun, one of the world's leading authorities on rockets and guided missiles.

Professor von Braun served as technical director of the German Fuel, Rocket, and Guided Missile Center at Peenemuende from 1937 to 1945 and came to the United States, under contract with the U. S. Army, in the latter year. He is now technical director of guided missile development for Army Ordnance at Redstone Arsenal, Huntsville, Ala.

"The conquering of space is now a question of determined engineering," Dr. von Braun said. "Today we have the basic elements to reach outer space. We can do it with present-day chemical fuels and well-known principles."

The first step in conquering space would be the firing of a space rocket. It would circle the earth at tremendous speed. Then, according to Dr. von Braun, would come the development of a space satellite or platform and an attempt to fly to the moon.

"Circling the moon would be a relatively simple step," he said. "Landing on the moon would be more tricky."

Dr. von Braun expressed the view that missiles are not a supreme defense against attacking planes because it would be impossible to establish enough guided-missile batteries to provide completely adequate defense.

Dr. von Braun lectured for two hours and, such was the keen interest in the subject, answered questions for another hour. About 800 members and guests attended the meeting.

Fairman B. Lee, Post secretary, presented the Association Gold Scholarship Key to Cadet Maj. A. L. Trine at Seattle University on May 22nd. Substituting for Post President Murray Aitken, he presented a desk pen set to Cadet Master Sergeant P. A. Smith of the Ordnance Unit at Seattle University as a special Puget Sound Post award for leadership.

• **AT WASHINGTON.**—The May meeting of the Washington Post was held in the National Press Club on May 20th. The guest speaker was Maj. Gen. Leslie E. Simon, chief of the Research and Development Division, Office of the Chief of Ordnance, who spoke on the procedures of Army Ordnance research and development. The election of officers and directors for the coming year was held during the meeting.

General Simon was graduated from the United States Military Academy in 1927. From 1940 to 1949 he was director of the Ballistic Research Laboratories at Aberdeen Proving Ground, Md. Since that time he has been Assistant Chief of Ordnance.

General Simon emphasized the fact that

Above, Ludlow King, left, president of the Washington Post, chats with Maj. Gen. Leslie E. Simon during Post meeting.

eighty-five per cent of the funds spent by Army Ordnance in research and development flow into programs which are being handled by private industry and educational institutions.

In reviewing method and procedure, General Simon said that Ordnance was

"driven to the conclusion that we would have to tap the great engineering resources of American industry to do the job. It is necessary, we believe, to maintain in government a hard core of qualified men to work with industry on these programs, men with real know-how; but the important thing is to leave with the contractor full responsibility for the job."

The following officers were reelected: Ludlow King, president; Fred T. Marshall, first vice-president; and T. J. McCloskey, second vice-president.

Elected for 3-year terms on the board of directors were Maj. Gen. E. L. Cummings, Robert F. Willey, Capt. Edward L. Woodyard, and Gerald J. Lynch.

Outgoing board members were C. E. Meissner, Brig. Gen. Merle H. Davis, Stanley A. Shank, and George Riviere.

Vice Adm. W. A. Kitts Elected President of Capital Cities Post at Lathams Meeting

The third annual meeting of the Capital Cities Post was held at Circle Inn, Lathams, N. Y., on May 14th. The dinner meeting was preceded by a meeting of the board of directors and chairmen of standing committees.

Directors present included E. E. Johnson, R. Z. Crane, W. A. Kitts, Ray Stearns, R. L. Fryer, E. H. Haller, E. D. Rhodes, C. E. Smart, and a representative of J. O. Amstuz. Also attending the meeting were Committee Chairmen J. M. McGarry and A. A. K. Booth. Post President E. E. Johnson presided.

Shown above at Capital Cities Post dinner meeting are, left to right: Col. R. Z. Crane, commanding officer, Watervliet Arsenal, Post vice-president; F. K. McCune, General Electric Company, principal speaker; E. E. Johnson, General Electric Company, retiring president; Vice Adm. W. A. Kitts, General Electric Company, new president; E. S. Webster, Watervliet Arsenal, secretary-treasurer.

Reports were submitted from the following committees: Industrial Preparedness, Public Information, Technical Progress, Meetings and Programs, Membership, and Student Activities. The Post now has 7 company members, 416 regular members, and 46 associate members.

The following officers were duly nominated and elected: Vice Adm. Willard A. Kitts, president; Col. Richard Z. Crane, first vice-president; Charles E. Smart, second vice-president; and Harry L. Erlicher, representative on the national Council. E. S. Webster is secretary-treasurer of the Post.

Inducted as new members of the board of directors were Ross L. Fryer, Eugene H. Haller, E. D. Rhodes, and Mr. Smart.

Retiring President Johnson presided at the dinner meeting which featured an address by F. K. McCune, general manager, atomic products division, General Electric Company, Schenectady, N. Y. His subject was "The Atom at Work."

Representatives of the Rensselaer Polytechnic Institute Student Chapter (Troy, N. Y.) attended the dinner meeting. Officers of the Chapter are Charles M. Pomeroy, III, president; William M. Lewis, vice-president; and Donald R. Rucinski, secretary. The total number of members and guests present was 125.

Dr. Wernher von Braun Tells Columbia River Post of "Rocketry and Space"

Dr. Wernher von Braun was the principal speaker at the Columbia River Post's public luncheon meeting at the Multnomah Hotel on May 15th. He is chief of the Guided Missile Development Division of Redstone Arsenal, Ala. His subject was "Rocketry and Space."

The annual meeting of the Post was held that same evening at the Benson Hotel. Marshall N. Dana, assistant to the president of the United States National Bank of Portland, lauded the ideals and achievements of the American Ordnance Association.

"Members of the Association," he said, "are not a bunch of speechmakers. They are seeking the guaranties of peace through industrial preparedness and ordnance research and development properly related to private enterprise.

"They work in a fascinating field. They obtain know-how at first hand. They accept and meet responsibilities personally for preparedness, public information, technical progress, student activities, meetings, and the increase of membership."

The Columbia River Post also took an active part in the observance of Armed Forces Day on May 16th. A parade through the downtown area of Portland included 35 units with close to 2,000 uniformed marching and mounted troops, as well as civic, fraternal, and veterans' organizations.

At a meeting of the Post board of directors on April 22nd the following officers and directors were elected for 1953-1954: W. L. McCarter, president; W. A. Gish, first vice-president; H. D. Kness, second vice-president; J. A. Gay, secretary; C. C. Tupling, treasurer. The following Post directors were also elected: B. J. Beattie, John Bergman, T. L. Bryant, Theodore Emerson, Paul Fowler, R. H. Fulbright, and Edward Haas.

• **AT SAN FRANCISCO.**—The annual luncheon meeting of the San Francisco Post was held in the Venetian Room of the Fairmont Hotel on May 8th in honor of Maj. Gen. Emerson L. Cummings, head of the Industrial Division of the Office of the Chief of Ordnance.

The Industrial Division is charged with procurement and production supervision of all ordnance matériel used by the Army, for many items for the Navy and Air Force, and for certain items being supplied to our allies overseas under the foreign military aid program.

As chief of this division since 1950, General Cummings has had supervisory responsibility for an operation sometimes described as "one of the biggest businesses in the world" during a very crucial period in the Nation's history.

General Cummings spoke on the Army Ordnance procurement program, both from the standpoint of procurement and production.

A. B. Layton, a director of the Post, was toastmaster of the meeting which was attended by 332 members and guests.

Those at the head table included E. J. McClanahan (representing T. S. Peterson), Samuel Kahn, Rear Adm. Morgan Watt, Dean Witter, Maj. Gen. Ray A. Robinson, B. C. Heacock, General Cummings, Mr. Layton, Maj. Gen. Walter E. Todd, W. E. Butts, Rear Adm. T. Earle Hipp, Lawrence S. Fletcher, Brig. Gen. Ralph I. Glascow, G. M. Greenwood, and Adm. H. D. Nuber (Ret.).

At a special table were Col. Hans G. Jepson, Col. John M. Stark, Col. C. E. Kelley, Col. Carroll D. Hudson, Col. Paul Steele, Col. W. B. Augur, D. A. Rhoades, Col. G. W. Dorn, 1st Lieut. C. H. Wuerz, and Milton Brooding.

Quad Cities-Iowa Post Sponsors Program of Plant Visits and Dinner Meeting

The May meeting of the Quad Cities-Iowa Post featured a meeting of the board of directors, a tour of Rock Island Arsenal, a tour of the International Harvester Farmall Works, a dinner at the arsenal, and the election of new officers and directors.

The board meeting was attended by G. L. Weissenburger, P. S. Mumford, G. H. Mathes, E. W. Ross, Col. C. A. Waldmann, C. E. Murray, G. A. Uhlmeyer, and D. L. Meyers.

It was reported by the secretary that the membership totaled 307—a slight decrease from the number reported a year ago.

In an effort to increase membership, many of the methods which had been previously attempted were discussed. These included the issuance of a list by the secretary to leading members in various localities so that personal contacts might be made in obtaining new members; questionnaires, issuable to the membership, so that deficiencies in the organization, noticed by the present membership, might be recorded; and a series of visits by officers of the Post to other localities in order to activate interest.

It was finally suggested that an advertising agency be contacted relative to improving this condition.

Mr. Weissenburger raised the question of a Chapter to the Post, probably to be located in Des Moines. He promised to contact members in this area with an aim toward establishing such a chapter. It was agreed by board members that, if the establishment of such a Chapter appeared to be favorably received by the Des Moines members, such action should be taken.

The dinner meeting of the Post was called to order by Post President Weissenburger. The number of members and guests present was 110.

Col. W. W. Warner, commandant, Rock Island Arsenal, gave the welcoming address, mentioning in particular the presence of ladies since this was the first time that ladies had been included in a Rock Island Arsenal meeting of the Post. He outlined the activities of the Tri-City area, calling attention to the fact that the arsenal was the center around which many of the area activities were crystallized. He clearly indicated that his welcome included future visits of Post members to the arsenal.

Mr. Weissenburger expressed his thanks to the committees for organizing the activities of the meeting. He also thanked the International Harvester Company and the arsenal management for the tours which the members of the Association had enjoyed in the afternoon. He expressed appreciation to the Associated Industries of the Quad Cities, represented at the meeting by Chester Anderson, and to the Iowa Manufacturer's Association, represented by Harry Linn, for their participation in the event.

The report of the nominating committee was read by Colonel Waldmann, and the following members were elected: Mr. Mumford, president, and Mr. Murray, vice-president. The new board of directors includes A. C. Danekind, L. M. Gildea, Mr. Mathes, L. A. Murphy, Mr. Ross, M. M. Schmidt, Mr. Uhlmeyer, Colonel Waldmann, C. D. Wiman, A. A. Collins, A. D. Matheson, Mr. Weissenburger, and W. W. Warner.

Col. Robert Haskell, Chief of the Chicago Ordnance District, was introduced. He spoke on the methods by which the district judges the efficient use of management.

Dr. Marvin Mundel, head of the Management School at Rock Island Arsenal, brought the busy day's activities to a close with a talk on "Improving Management of an Organization."

Los Angeles Post Holds Annual Meeting

A capacity crowd of more than 330 members and guests at the annual dinner meeting of the Los Angeles Post heard Maj. Gen. Emerson L. Cummings, chief of the Industrial Division, Office of the Chief of Ordnance, laud the "Southern California industrial family" for greatly exceeding the expectations of Washington in its ordnance production.

General Cummings revealed that the Los Angeles Ordnance District "in this time of only partial mobilization has nearly $600 million worth of contracts on its books, more than four times the peak load of World War II."

The dinner meeting was held at the California Club on May 12th.

General Cummings pointed out that the Pacific Southwest "has made some of the most outstanding contributions to scientific developments in Ordnance that we have ever witnessed" in its contributions in the field of guided missiles as well as having an outstanding record in conventional ordnance production. He said the area now has assembled the greatest number of guided-missile scientists and development engineers in the country.

Dr. Louis G. Dunn, head of the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, gave the large audience a startling account of the tremendous strides that have been made in the development of guided missiles.

Robert C. Geffs, newly elected to the presidency of the Post, opened the meeting and introduced Kenneth T. Norris who acted as toastmaster. The annual report was given by William A. Wilson, retiring Post president. The many activities and achievements of the Post during the past year were due in large measure to Bill Wilson's able leadership.

The officers for the coming year in addition to Mr. Geffs are: Frederic W. Conant, vice-president; Robert W. Reniers, secretary; and Samuel K. Rindge, treasurer.

The board of directors includes Thomas T. Arden, Dr. Dunn, Edgar C. Hummel, Earle M. Jorgensen, Patrick W. Lizza, Walter C. Main, James P. McCafferty, Mr. Norris, John B. Rauen, Carlton B. Tibbetts, and Mr. Wilson.

At Los Angeles Post meeting Robert C. Geffs, left, new president, and William A. Wilson, retiring president, greet Maj. Gen. Emerson L. Cummings, chief of the Ordnance Industrial Service, right, who was the principal speaker.

• **AT SYRACUSE.**—One hundred and fifty members and guests of the Syracuse-Central New York Chapter attended a dinner meeting at which Brig. Gen. Tom C. Rives, U.S.A.F. (Ret.), now manager of the General Electric-Cornell Electronics Center, gave the principal address. His subject was "Push-Button Warfare?"

General Rives' conclusion was that "we have the push button and a number of the wires and components with which to initiate push-button warfare, but we have not yet designed a complete system that can be used in such warfare."

• **AT LAFAYETTE.**—The annual spring banquet of the Purdue Ordnance Club was held in the Purdue University Memorial Union on April 29th with fifty members attending. President William Watts presided.

Following the banquet and business meeting, Col. Clarence A. Cozart, deputy chief of the Cincinnati Ordnance District, presented a talk on "The Evaluation of the Career of an Army Ordnance Officer." Colonel Cozart included in his remarks a very interesting discussion of his experience while assigned to the Chinese Army during World War II and finished up with a question-and-answer period.

Under the faculty direction of Lieut. Col. T. E. Carney, assistant professor of military science and tactics at Purdue, the club has had a very successful year. Included among its activities was a field trip to the Haines Stellite plant in Kokomo, Ind., and a trip to the National Guard Firing Range at Frankfort, Ind.

• **AT WATERTOWN.**—Members of the Massachusetts Institute of Technology Post, under the leadership of Lieut. Col. Samuel L. Hall and Capt. Willard Anderson of Army Ordnance, spent April 10th at Watertown Arsenal where they were given an opportunity to examine the Skysweeper and the 280-mm. gun.

• **THE GENERAL'S CANE.**—In a ceremony unique in the history of Ordnance, a trophy case containing the famous cane of the late Brig. Gen. Tracy C. Dickson was dedicated at Watertown Arsenal in the presence of about a dozen Ordnance veterans who had been well acquainted with, or who had served under, the distinguished Ordnance officer and commander of Watertown.

The case, made of walnut and glass, is fastened to the wall of Col. Benjamin S. Mesick's office in the arsenal. In the case reposes the cane, General Dickson's photograph, a tribute to him that was published in ORDNANCE magazine, and a pair of stars he wore as a brigadier general.

Mrs. Fay, formerly General Dickson's secretary, pulled the curtains aside to open the case to the public.

The speaker on this unusual occasion was Brig. Gen. Thomas K. Vincent, commandant, Redstone Arsenal, Huntsville, Ala. General Vincent served with General Dickson for six years at the arsenal.

"General Dickson," he said, "was one of the finest, kindest, and most far-seeing, clear-thinking, highly skilled technical men that I ever knew. He was away ahead of his time, and the contributions that he made to the Ordnance Department will long endure. He made his influence felt, I believe, on more young officers of the Ordnance Department than any other one man, and the lessons he taught were absorbed by most of them."

General Vincent then quoted a statement made by the late King George VI of England: "'The true leader is a man with a gift of vision and the desire in his soul to leave the world a little better than he found it. Such a leader does not demand immediate results but is willing to strive for what happens to be unattainable, leaving it to his successors to gather the fruits and to be content if he can feel that what he did made the ultimate harvest possible.'"

"That, to me," said General Vincent, "was General Dickson."

• **JOHN D. SMALL** has been elected vice-president of Pressed Steel Car Company and will make his headquarters in the company's executive offices in New York.

Mr. Small has an extensive record of distinguished service to the Nation both in the Navy and in defense production jobs. He was formerly Chairman of the Munitions Board, vice-president of the Emerson Radio and Phonograph Company, president of Maxson Food Systems, Inc., and executive vice-president of the Dry-Ice Corporation of America.

He was national Administrator of the Civilian Production Administration, the agency that succeeded the War Production Board, during 1945-1946.

Mr. Small is a graduate of the United States Naval Academy and saw Navy service in both World Wars. In World War II he was Deputy Director of the Army-Navy Munitions Board and later was executive officer of the War Production Board. He holds the rank of commodore in the Naval Reserve.

• **W. R. G. BAKER,** vice-president and general manager of the General Electric Company's Electronics Division and a member of the American Ordnance Association, recently received the Medal of Freedom Award. Under Secretary of the Army Earl D. Johnson made the presentation in the Pentagon.

The medal is awarded by the Army to civilians for the performance of meritorious services which have aided the United States in its efforts against an enemy. Dr. Baker received the award for accelerating the application of electronics to the solution of Army research and development problems.

During the summer of 1952, Dr. Baker visited the combat area in Korea with a group of civilian scientists to study the problem of utilizing electronic devices and principles to the maximum extent in modern war, thereby increasing the effectiveness of the individual soldier and reducing the cost of human life.

As a result of this visit, the citation declared, Dr. Baker "furnished advice and guidance to the Chief of Staff and the Secretary of the Army which will have a significant impact on the Army's future effectiveness."

• **BRIG. GEN. GERSON K. HEISS,** a member of the American Ordnance Association and Ordnance officer for Army Forces Far East Headquarters, was decorated with the South Korean Ulchi Distinguished Military Service Medal with Gold Star for outstanding service to the ROK Army.

In a special ceremony in Yokohama, the medal was presented to General Heiss by Maj. Gen. Duk Shin Choi, Republic of Korea liaison officer.

• **WIRT WILSON,** for nearly fifty years a leader in insurance in Minneapolis and one of the founders of the Northwest Post of the American Ordnance Association, died in Minneapolis on April 16, 1953. He was chairman of the board of Wirt Wilson & Company, insurance consultants, which he founded in 1913.

A native of Winona, Minn., Mr. Wilson was graduated from the University of Minnesota School of Law in 1899. During the Spanish-American War he served with the 13th Minnesota Regiment in the Philippine Islands.

He entered the insurance field in 1904 as a partner in the firm of Smith & Wilson and later served as Minneapolis manager of the United States Fidelity & Guaranty Company.

Mr. Wilson served on the organization committee and on the first board of directors of the Northwest Post. He was a guiding light in all plans and programs of the Post and gave unfailing assistance to the progress of industrial preparedness in that area prior to and during the Second World War.

His close connection with industry in and around Minneapolis in addition to his deep patriotic concern for the national defense were the bases of his outstanding contribution to Ordnance preparedness in his native state.

ORDNANCE R.O.T.C. MEDALISTS

A scholarship key and a year's membership in the Association are presented each year by the A.O.A. for award to the outstanding Ordnance student in each Ordnance R.O.T.C. unit of American colleges. This year awards were made to students at the following institutions:

University of California.—Cadet Capt. Joseph M. Viglizzo was awarded the Association scholarship key at the Graduation Review on June 4th. A chemical engineering student, he was commanding officer of Ordnance Company F, First Regiment.

Clemson Agricultural College.—John Allen Porter was selected to receive the Association award. Specializing in chemistry, he had an excellent scholastic record during his entire four years on the campus.

Colorado Agricultural and Mechanical College.—Robert C. Kreycik was awarded the Association key. Majoring in bacteriology, he was recently designated a distinguished military student.

Cornell University.—Cadet Lieut. Col. Richard T. Groos was selected to receive the Association award. His R.O.T.C. rating was first out of seventy-two Ordnance seniors. He is a graduate of the College of Mechanical Engineering and received the General Ralph Hospital Award last year.

Dartmouth College.—Thomas Tyler was the recipient of this year's award. He is a junior in the Thayer School of Engineering and one of the outstanding students on the campus.

Georgia Institute of Technology.—Cadet Maj. George W. Adams was awarded the Association key at the Annual Honors Day ceremonies on May 13th. A chemical engineering student, Mr. Adams was not only an outstanding cadet but also attained an A average and was selected for many top honorary societies on the campus.

Gonzaga University.—Cadet Maj. Donald L. Lewis received the A.O.A. scholarship key on May 24th. He was a distinguished military student and a university honor student.

Hofstra College.—The A.O.A. gold key recipient was Cadet Maj. Peter J. Daly. Presentation was made during a review in his honor on May 12th. He was regimental adjutant and very active in the R.O.T.C. program.

University of Illinois.—Robert N. Quade was selected to receive the A.O.A. scholarship key. Mr. Quade is a junior mechanical engineering student and holds the John Morse Memorial Scholarship. He is a member of Tau Beta Pi and Pi Tau Sigma, honorary engineering fraternities.

Lafayette College.—The A.O.A. key was awarded to Cadet Capt. Howard D. Hendrickson during a Corps review on May 18th. This is the second time Cadet Hendrickson has received the Association award. He was designated a distinguished military student in 1952 and is a member of the Scabbard and Blade Society.

Lehigh University.—Cadet Lieut. Col. Roy C. Anderson was selected as the outstanding cadet of the entire corps. Presentation of the Association award was made at a Regimental Ceremonial Parade on May 11th.

Louisiana State University.—The Association scholarship key was awarded in an impressive ceremony before the entire cadet corps on May 12th to James J. O'Quinn. Mr. O'Quinn has been tendered a Regular Army commission.

Marshall College.—Cadet Lieut. Col. Fred L. Reid was designated to receive the A.O.A. award again this year. He was cadet battalion commander during his junior and senior years, and was a distinguished military student.

Massachusetts Institute of Technology.—Cadet Lieut. Col. Herbert H. Richardson was awarded the Association key at the review on May 14th. He was an outstanding student in mechanical engineering.

J. M. Viglizzo | J. A. Porter | R. C. Kreycik | R. T. Groos | G. W. Adams | D. L. Lewis

P. J. Daly | R. N. Quade | H. D. Hendrickson | R. C. Anderson | J. J. O'Quinn | F. L. Reid

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R.O.T.C. Medalists

H. H. Richardson G. W. Pardee

Michigan State College.—Cadet Lieut. Col. G. Winfield Pardee was awarded the A.O.A. scholarship key. He was a distinguished military student, cadet regimental executive officer, and a member of the Scabbard and Blade drill team.

University of Michigan.—John W. Messer was awarded the A.O.A. scholarship key as the outstanding Ordnance Corps Cadet at the university. A graduate student in business administration, Mr. Messer expects to go on active duty in August. A leader in many student activities, he is a member of Scabbard and Blade and the Druids Senior Honorary Society.

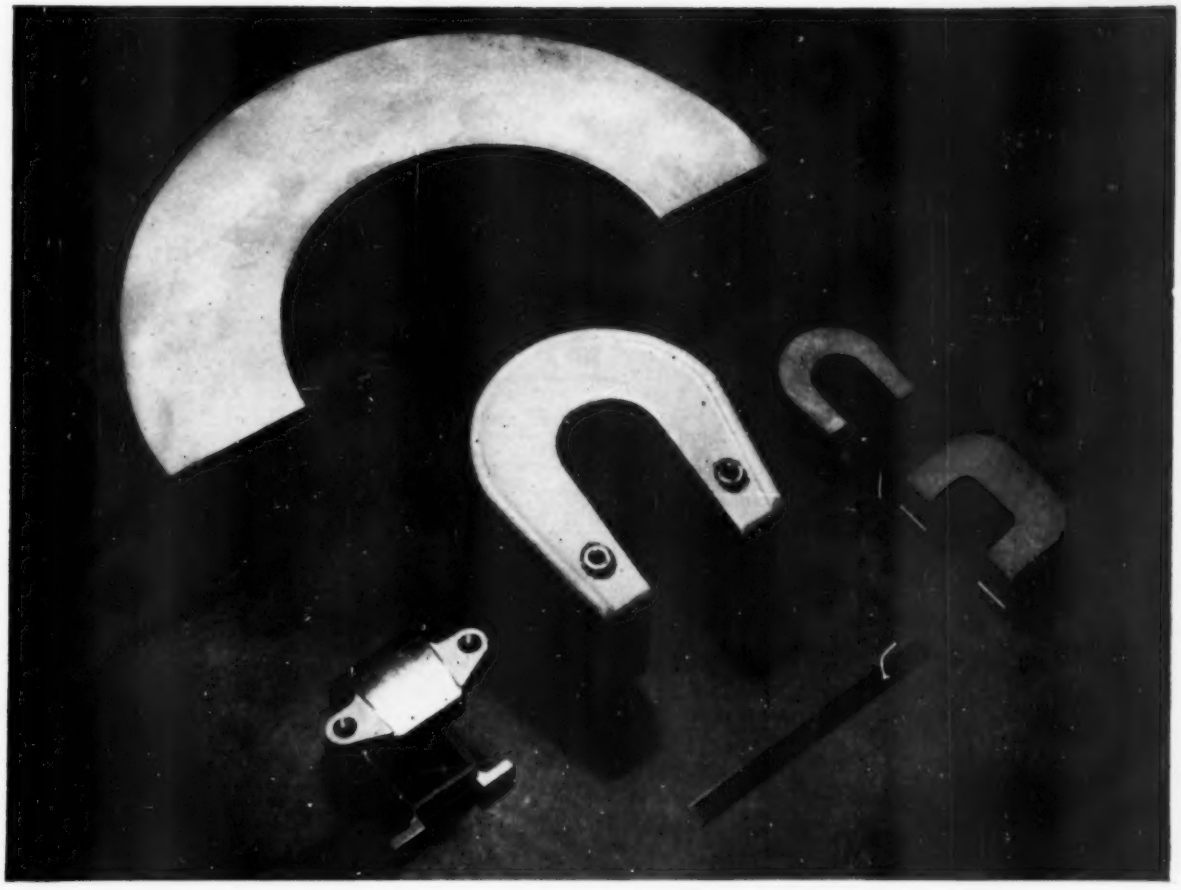
University of Minnesota.—The Association scholarship key was awarded to William E. Engebretson, a junior in the Institute of Technology. Mr. Engebretson is a distinguished military student.

University of Nebraska.—The A.O.A. award was presented to Cadet 2nd Lieut. Howard M. Doty at a joint Army-Air Force R.O.T.C. parade on May 12th by Dr. Floyd W. Hoover, director of registration and records at the university. Mr. Doty is a member of the Pershing Rifles and has been an outstanding military student.

North Carolina State College of Agriculture and Engineering.—The Association scholarship key was awarded Maxwell Reid Thurman at the Annual R.O.T.C. Awards Ceremony in Riddick Stadium on May 15th. He was the regimental cadet colonel and holder of the Third Army Certificate of Meritorious Achievement.

Oklahoma Agricultural and Mechanical College.—Cadet Maj. James R. Riede has

W. E. Engebretson J. W. Messer



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R.O.T.C. Medalists

H. M. Doty M. R. Thurman

been selected to receive the A.O.A. scholarship key. He plans to make the Army his career, having been designated a distinguished military student.

University of Oklahoma.—Charles Michael Fullerton was selected to receive the Association award. A distinguished military student, he held the rank of cadet colonel. He is a junior, majoring in physics, and a member of the Scabbard and Blade Society.

Purdue University.—William Earl Watts was awarded the A.O.A. gold scholarship key. A mechanical engineering student, he was president of the Ordnance Club, the Scabbard and Blade Society, and the Pershing Rifles drill team. Designated a distinguished military student, he was offered a Regular Army commission.

Rutgers University.—The Association key was awarded to Cadet Douglas Evan Monks. A distinguished military student, he was a member of the Scabbard and Blade Society and represented his university at the U. S. Military Academy Sesquicentennial Anniversary celebration this year.

Seattle University.—Arthur L. Trine, a veteran of twenty-seven months overseas during World War II, was awarded the A.O.A. key at an assembly of the entire Cadet Corps. Cadet Trine was president of the R.O.T.C. Cadet Association.

The Military College of South Carolina.—Cadet E. Yaschik was awarded the A.O.A. scholarship key. He is a member

C. M. Fullerton J. R. Riede

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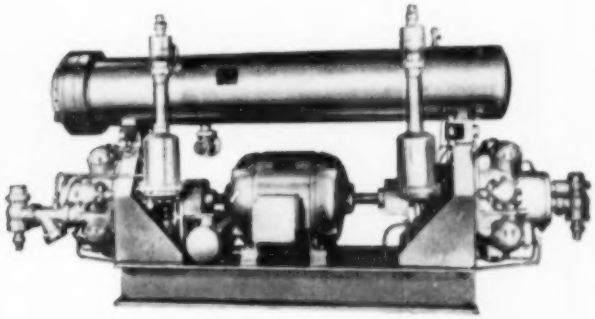

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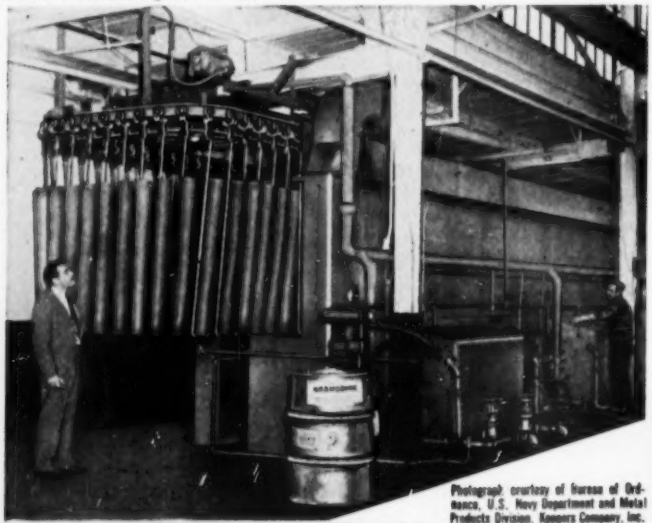

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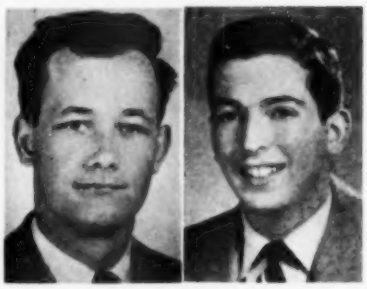
CHEMICALS ACP PROCESSES

R.O.T.C. Medalists



W. E. Watts D. E. Monks

of the Citadel Yacht Club and the American Ordnance Association. He is specializing in business administration. An outstanding student, he holds the rank of staff sergeant in the Citadel Cadet Corps.

Agricultural and Mechanical College of Texas.—The Association scholarship key was awarded to Lieut. Billie D. O'Neal, a Navy veteran of World War II.

A. L. Trine E. Yaschik

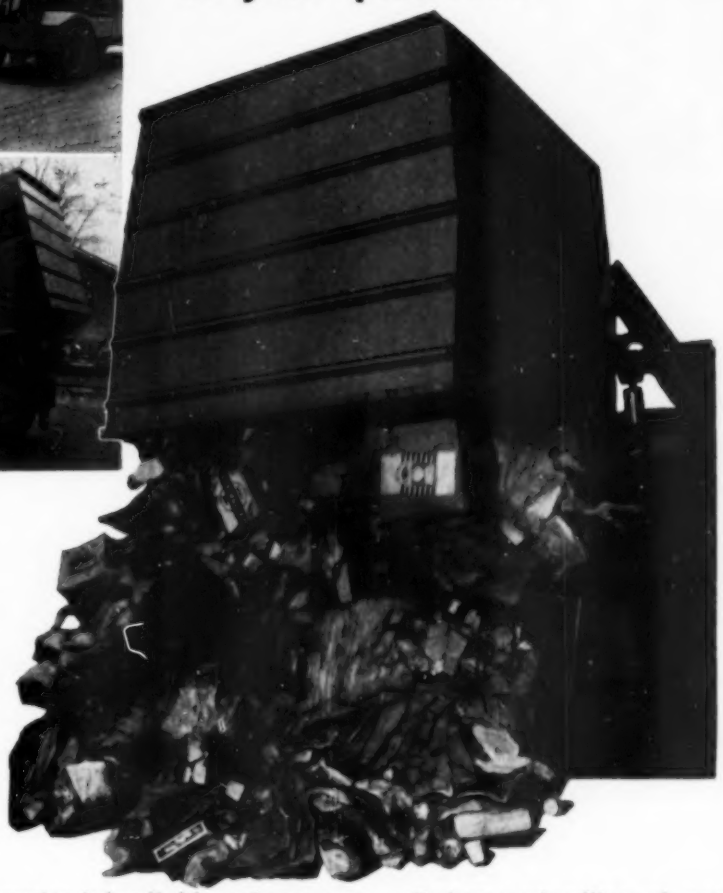
He consistently received the highest grade in his military work and was designated a distinguished student.

Utah State Agricultural College.—The recipient of the Association award was Cadet Lieut. Col. Lawrence Paul Jones. Presentation of the award was made during a brigade review in conjunction with the annual inspection on May 15th.

Virginia Polytechnic Institute.—Cadet Walter T. Darnell was awarded the A.O.A. scholarship key. He was one of five winners of the 1953 Scholarship Award Contest of Tau Beta Pi.

W. T. Darnell L. P. Jones

Rubbish Disposal is only ONE of the Cost Cutting jobs for the Dempster-Dumpster in your plant...



It's amazing, almost to the point of fantasy, yet so soundly real, what the minds of men in all types of industry have cooked up for more efficiency and reduced costs with the Dempster-Dumpster.

Hundreds of plants are handling materials of practically every description with one truck-mounted Dempster-Dumpster serving scores of detachable containers. Here are just a few. Oils, gases, and liquids handled in our Tank Type Containers . . . tools and equipment in our Tool Shed Type Container . . . containers on casters placed for receiving steel chips from lathes or at conveyors for receiving finished products . . . container with doors and windows, replacing shacks for plant guards or nightwatchmen . . . containers built to handle chlorinator ash residue of approximately 1500° F. and there are dozens more.

Containers are placed wherever material accumulates. When loaded each is picked-up, hauled and emptied (as illustrated above) . . . or load set down intact. The entire operation is handled by only one man, the driver, by hydraulic controls in cab.

The containers are built in capacities up to 12 cu. yds. and each is designed to suit the materials to be handled—be they bulky, light or heavy . . . solids, liquids or dust.

One Dempster-Dumpster, with driver, does the work of 3 to 5 conventional trucks . . . eliminates trucks and crews standing idle . . . eliminates rehandling of materials and increases efficiency and good plantkeeping.

If you have even any remote idea that this equipment could be adapted to your operation, by all means contact us because being without the Dempster-Dumpster System could easily be costing your company thousands of dollars annually. Manufactured and sold exclusively by Dempster Brothers, Inc.

One Dempster-Dumpster Handles All Containers . . . . All Sizes . . . . All Designs

DEMPSTER BROTHERS, 973 Shea Bldg., Knoxville 17, Tennessee

Rockwell Report

by W. F. ROCKWELL, JR.
President
Rockwell Manufacturing Company

CUTTING MANUFACTURING COSTS gets more and more difficult. Labor costs per unit can be held in line only by more efficient production, and after a couple of decades of pretty careful industrial engineering, the short-cuts are harder and harder to find. Material costs are relatively inflexible, too.

For some years, we've been chopping away at indirect costs, improving materials handling, plant layout and every factor that held much promise. Finally, it gets down to the product itself.

That's why, although we spend a great deal on the engineering development of new products, an even greater amount of money goes to the improvement of present products, both to make them more salable, and just as important, to reduce the costs of their manufacture.

Strangely (or perhaps an industrial designer would say it isn't strange) in most cases where a new design has reduced costs it has also resulted in an improved product.

The big problem is that many engineering projects that start out as cost-cutting jobs, become cost-holding jobs because in the time needed to redesign, the creeping increases cut off the savings that were expected.

* * *

New Rockwell Products: Our meter division now markets an all-stainless steel meter for measuring corrosive liquids common to the chemical, petrochemical, food, pharmaceutical and industrial processing fields. Built entirely of stainless steel, the meter operates at pressures up to 125 pounds per square inch at from 20 gallons per minute minimum and 100 gallons per minute maximum. It can be equipped for remote registration and quantity control . . . Our Nordstrom Valve Division is in production with a new tamperproof lubricant-sealed service and meter cock for gas service . . . Rockwell Tools, Inc., a subsidiary, now offers five packaged combinations of hand saws including not only general purpose and pruning saws, but also nested blades for special sawing problems.

* * *

Recently the editor of a magazine for boys came to our Delta Power Tool Division for assistance in the preparation of an article on home workshops. Their reason for doing the story was that they found, in a survey, that in homes with workshops there was often an unusually strong bond between father and son. The home workshop, he pointed out, was common ground on which all ages could meet.

* * *

One of the advantages in a diversified company like ours is being able to move quickly, and we wage a constant battle against building up non-essential system and red tape.

We want to have the advantages of a small business in being able to shift quickly if conditions change. So our individual plant managers get a lot of leeway and home office control is more advisory than absolute.

To further be sure we're ready for change, we've had each division prepare a budget based on 75 per cent of actual anticipated sales for 1954. In other words, we've asked them what they intend to do if sales should go as much as 25 per cent under estimates. One division, by the way, is so increasingly optimistic we're thinking about asking them for a 125 per cent budget.

These 75 per cent budgets don't just cut everything 25 per cent. The division manager is expected to review all costs and sales possibilities on the assumption that some things can't be cut at all; some things can perhaps be eliminated completely.

One of a series of informal reports on the operations and growth of the
ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PA.
for its customers, suppliers, employees, stockholders, and other friends

FROM THE RECORD

A SCIENTIST'S CREED

DR. A. V. ASTIN
Director, National Bureau of Standards

The Bureau staff believes first of all in the importance of scientific research as a means of intellectual and spiritual advancement, as the foundation of our technological economy and high standard of living, and as the bulwark of our national security.

We believe in the teachings of Galileo that theory and hypothesis must conform to the results of experimentation and observation. We believe in the philosophy of Lord Kelvin that basic understanding in science depends on measurement—the reduction of observation to numbers.

We believe further that the reduction of observation to meaningful numbers requires the development and maintenance of uniform standards for physical measurement and that this need provides the first and primary reason for the Bureau's existence.

A Challenging Activity

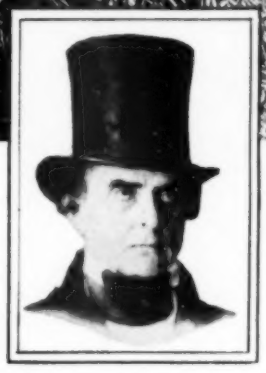
The development and maintenance of the standards for physical measurement, with the associated calibration procedures, is to us a challenging and dynamic activity. This standards work must not only keep abreast of the expansion of the frontiers of science, but in the older regions there is a continuing demand to increase the precision and reliability of measurement.

We believe that there is romance in precision measurement and that ability to extend the absolute accuracy of measurement by one decimal place frequently demands as much in ingenuity, perseverance, and analytical competence as does the discovery of a new principle or effect in science.

We believe further that many of the important advances in science are possible only through the availability of instruments of high precision which enable the measurement of small differences or minute effects.

We stress reliability and accuracy in our operations and in checking and rechecking our results. In fact, an inadvertent error of ten parts in a million (representing a whole wave length of light) in a length calibration made some months ago was a cause of grave concern to the Bureau's management, and there was no rest until the cause of the error was located and remedial action was taken to prevent a recurrence.

We stress objectivity and fairness in our operations and attempt to insure them



Hunting—another great American heritage

Words that stirred a nation . . . fiery speeches hurling dismay and defeat into the hearts of political opponents . . . these cast the spotlight on Daniel Webster, dynamic orator. In his leisure time, like many another red-blooded citizen of his day, Webster enjoyed every thrill of hunting and the outdoor life.

A crack shot, he often roamed fields and winding trails in search of game. Recounting a hunting trip to his family, Webster said: "My friend had already found a fresh deer track to the eastward—told me to wait at the top of a hill and keep my ears opened and my eyes peeled. For two hours, I stood there, expecting every moment to hear the dogs or see the deer." Every emotion of the marksman . . . tenseness . . . disappointment . . . joy and satisfaction were keenly felt by Daniel Webster, hunter.

For heart-stirring action and thrills, hunting can't be matched by any other sport. It has long built character, self-reliance and endurance . . . given millions of hunters clean, healthy enjoyment.

You can help promote the popular sport of hunting by working in local and national conservation programs. Remember—conservation today means good shooting tomorrow! E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington 98, Delaware.

N·R·A RANGER

WRITE FOR FREE BOOKLET on how to start a rifle club . . . win Ranger Shooting Emblems. Sportsmen's Service Bureau, Department D-2, Sporting Arms and Ammunition Institute, 250 E. 43rd Street, New York 17, N. Y.

DU PONT
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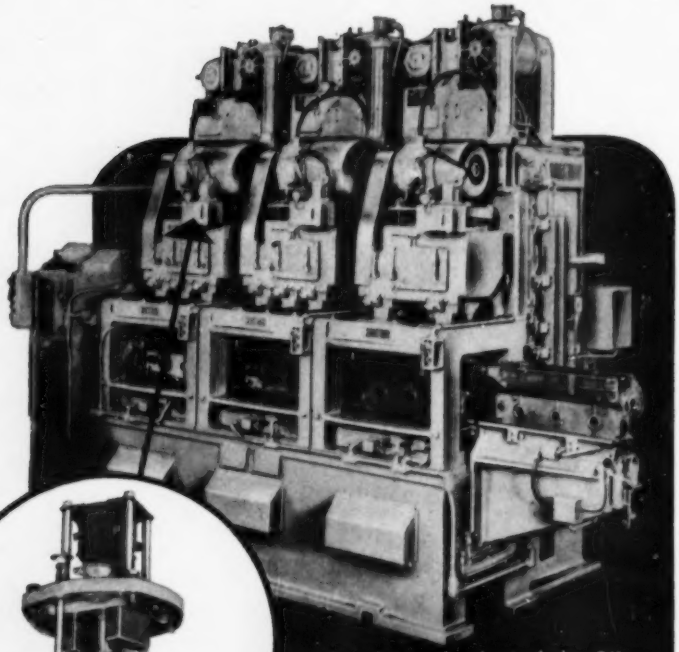
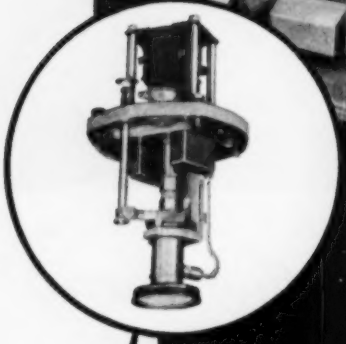
DU PONT SPORTING POWDERS

WORLD-FAMOUS SINCE 1802

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

VERSATILE *lubrication*





Sundstrand selected the Bijur Type "E" Solenoid-Operated Lubricator to protect the bearings on their special Rigidmil to assure ease of mounting and control. All way and feed screw bearings are *properly lubricated with just the right amount of* oil by lubricators cycled to the travel of the milling heads.

Bijur Type "E" Lubricators offer added *versatility of application and positive control.* They can be mounted anywhere on a machine since they operate without direct connection to moving parts.

Investigate the advantages of automatic lubrication for equipment you manufacture. Bijur's experienced engineers are qualified to aid you in designing lubrication systems for machines now in production or in the planning stage.

For the best in automatic lubrication . . . insist on Bijur.

BIJUR

LUBRICATING CORPORATION
Rochelle Park, New Jersey
Pioneers in Automatic Lubrication

285 N-10

From the Record

by a willingness to accept the results of well-planned reproducible experiments and the logical conclusions therefrom. We follow as far as possible the established or clearly defined observational techniques and analytical procedures of science but welcome the opportunity to evaluate and accept new ideas and techniques.

We believe that scientific conclusions should be made only by following such procedures. We believe further that complete freedom of inquiry in scientific investigation is essential to insure not only the soundness of a particular set of results or conclusions but also the development and healthy progress of science itself.

Related closely to this is our conviction that a substantial portion of the program of any sound scientific or technical laboratory should be devoted to fundamental or nonprogrammatic research. Such provisions afford an opportunity for the more imaginative scientists to explore freely ideas of their own choosing and help to provide vigor and strength to the entire laboratory.

Free Interchange Essential

We believe that communication between scientists, through discussions, meetings, and visits between laboratories, is essential to the development and evaluation of new ideas. For there is no ultimate authority or supreme court in science except that resulting from general acceptance through free interchange.

The results of a particular experiment are not considered established unless they can be reproduced by other observers, in other laboratories, and with different equipment. The conclusions of a theory or hypothesis are not considered valid until they survive the scrutiny and criticism of other analysts and/or conform to the results of experience.

Therefore, we believe that the broad dissemination and publication of the results of research investigations are essential to the healthy progress of science, to be limited only by strict considerations of national security . . .

We believe that in times of national emergency the facilities and resources of the National Bureau of Standards should be as far as possible placed at the disposal of those charged with the country's defense. This was in fact done during the two World Wars. Even during peacetime or periods of limited emergency there is an appreciable utilization of the Bureau's facilities by the defense agencies.

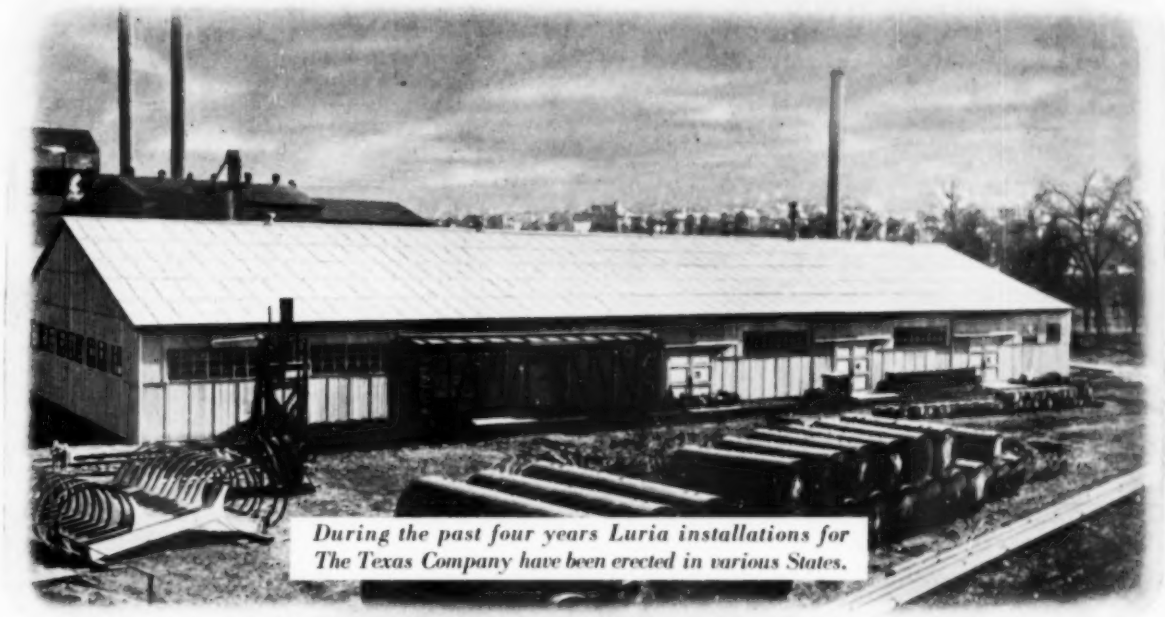
Since World War II, and particularly since the Korean episode, these activities have grown substantially until now more than three-quarters of the Bureau's staff

Another Industrial Leader...

The Texas Company

continues to build with

LURIA Standardized Buildings



During the past four years Luria installations for The Texas Company have been erected in various States.

ONLY LURIA offers you the SPEED and ECONOMY of STANDARDIZATION ...plus all the ADAPTABILITY and DURABILITY of CUSTOM-DESIGNED UNITS

Luria Standardized Buildings live up to their promise of high-speed construction coupled with low cost . . . of standardized design adaptable to almost *any* type of architectural treatment that best suits your *individual* needs . . . of permanent structures that meet and surpass the most stringent building code requirements. This is conclusively proven by Luria's outstanding record of *repeat* orders from the world's great industrial leaders . . . and from businesses of modest size.

If you are planning expansion now or in the future, the list of companies who *reorder* Luria buildings will impress you — just as the many advantages of Luria Standardized Buildings will interest you.

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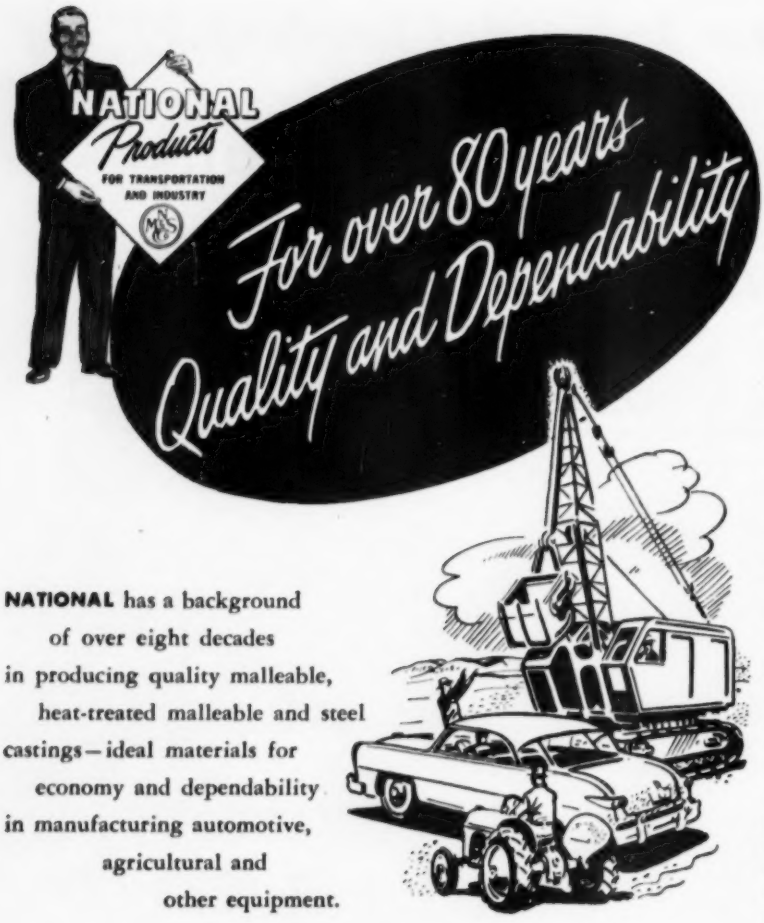
500 FIFTH AVENUE, NEW YORK 36, N. Y.
ATLANTA • PHILADELPHIA • BOSTON • CHICAGO • WASHINGTON, D. C.

LURIA *Customers are REPEAT Customers*



NATIONAL has a background of over eight decades in producing quality malleable, heat-treated malleable and steel castings—ideal materials for economy and dependability in manufacturing automotive, agricultural and other equipment.

NATIONAL's unparalleled experience—coupled with a continuing metallurgical research program, rigorous quality control standards, and completely mechanized foundries in strategically located cities—is at your disposal.

Sales offices and engineering facilities are located at all five plants listed below.

SEE

A 16mm Technicolor film. Narrated by Edwin C. Hill, this 27-minute film tells how malleable iron is made . . . tested . . . used . . . how its production economy, ductility, machinability, toughness will give you a better finished product. Available for group showings. A-5017

PLANTS LOCATED IN

Sharon, Pa., Cleveland 6, Ohio, Indianapolis 6, Ind., Melrose Park, Ill., and Chicago 50, Ill.

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY
CLEVELAND 6, OHIO

From the Record

are working on problems for the Department of Defense. This means that the general character of the Bureau's work and the nature of its fiscal support is markedly different than it was fifteen or twenty years ago.

Whether or not this is a desirable utilization of the National Bureau of Standards under the present conditions is undoubtedly a question which will be considered by one of the special study committees. We will welcome their recommendations and advice on this matter.

An Alert Staff

We believe that in order for the National Bureau of Standards to carry out its various functions and activities we must have an alert and competent staff, suitable equipment and facilities, and an environment favorable to scientific investigation and methodology. This environment or climate essentially means the provision of the opportunity to practice the beliefs I have been stating.

We believe that there should be suitable recognition and promotion of the more productive and creative scientists together with a careful weeding out of the nonproductive. We believe that the highest positions in the civil service should be available to the most outstanding scientists and engineers and that it should not be necessary to encumber them with administrative responsibilities in order to attain such positions. This principle is fortunately recognized by the Civil Service Commission.

We believe that we should bring in new blood by the recruitment and training of young scientists and by promoting them to more senior positions as rapidly as they develop and opportunities open. We further believe that education should not cease when an individual joins our staff, and we take pride in our graduate school. . . .

We take pride in our many illustrious alumni now serving in responsible positions in industry and elsewhere in government, and we have reason to believe that they value the experience gained as members of the Bureau's staff.

We take pride in the concept of service, in providing assistance to science, to industry, and to government.

We believe in the dignity of the government service and further believe that the primary incentives and rewards of a civil-service scientist are not financial but rather stem from the pride in organization and its functions and from the sense of satisfaction which comes from participating, even in small ways, in the solution of problems of national importance.—*From an address before the American Physical Society, Washington, D.C.*

"What goes on here, Mr. Beaver?"

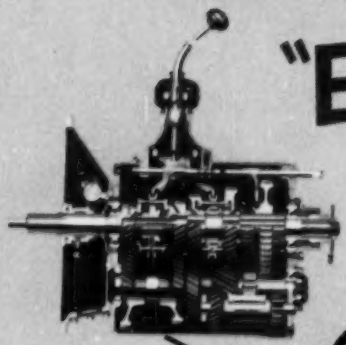
Operation *completely submerged* . . . army trucks travelling under many feet of water . . . accomplishing missions impossible without such 100% amphibious ability!

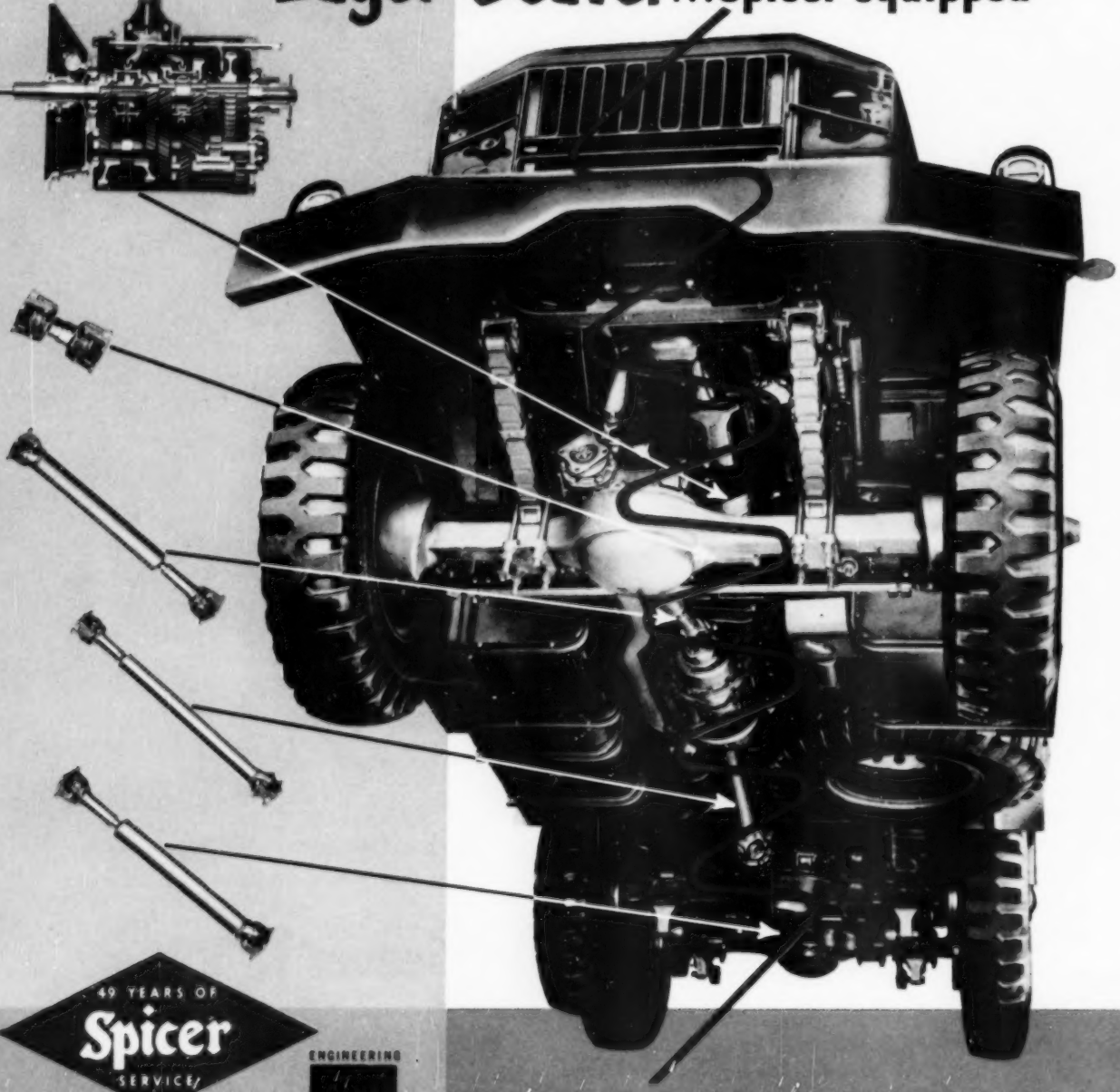
Among the new military vehicles, these versatile 2½-ton trucks are the most revolutionary and efficient. On land or 10 feet under water, their dependable and uninterrupted service is achieved with the aid of Spicer Fully-Synchronized Transmissions, Spicer Propeller Shafts and Spicer Universal Joints.

Designing, Developing, Engineering, Manufacturing and Service

Spicer

Ambitious amphibious "Eager Beaver"...Spicer-equipped





49 YEARS OF Spicer SERVICE

ENGINEERING MANUFACTURING

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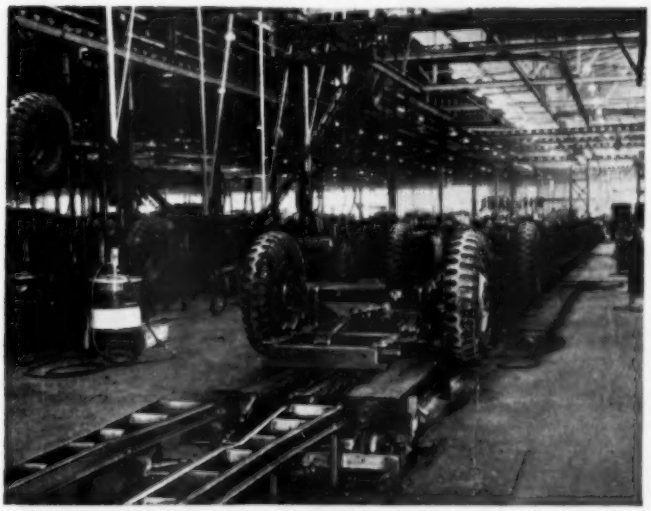
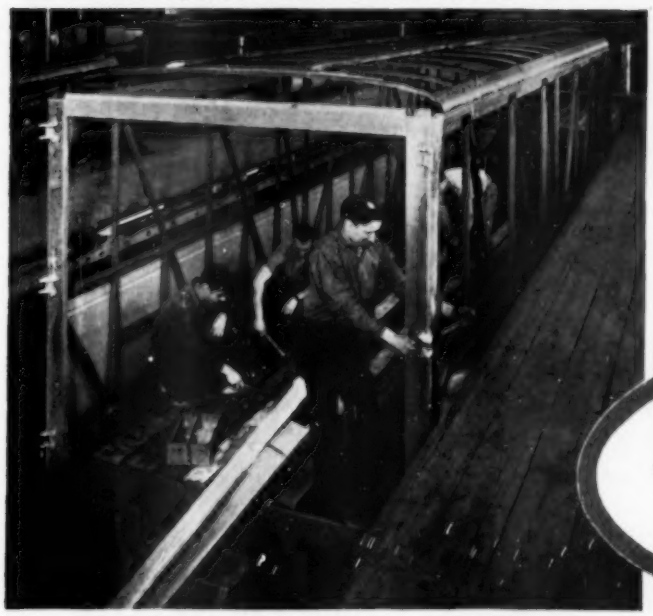
Call it the Main Artery. Call it the Life Line. Call it any name that describes the driving flow of power delivered through the Spicer Transmission, Propeller Shafts and Universal Joints in the new completely amphibious Army trucks.

These time-proved Spicer products have been serving civilian and military needs in large volume for many years in trucks, buses, tanks, and other vehicles. Spicer is geared to big production of Fully Synchronized Transmissions and other power delivery units, to meet your requirements for greater economy and ease of operation in commercial vehicles.

TWO LINES FOR DEFENSE



Military Trailers in Production at Avon Lake, Ohio.



Dry Freight Aerovans in Production at the Avon Lake Plant.

SIDE BY SIDE in Fruehauf's giant Avon Lake manufacturing plant, these two precision-production lines turn out a continuous quota of military and domestic Trailers vital to the defense needs of the nation. Special Military Trailers on the first line, and conventional highway-freight units on the second, both contribute directly to the efficient functioning of America's military supply system.

MANY SHARE THE JOB

Fruehauf's seven American manufacturing plants and their many hundreds of sub-contractors all share in this important job of supplying the nation with essential defense transportation. For Fruehauf Trailers serve not only in the regular delivery of necessary goods and materials to every American industry and community, but also as an indispensible part of the Armed Forces.

FACILITIES AND EXPERIENCE AVAILABLE

Fruehauf's complete Trailer-manufacturing facilities — largest in the world — and Fruehauf's vast fund of engineering know-how and experience are already hard at work and always available for additional production orders or sub-contracts that will serve America.

World's Largest Builders of Truck-Trailers

FRUEHAUF TRAILER COMPANY
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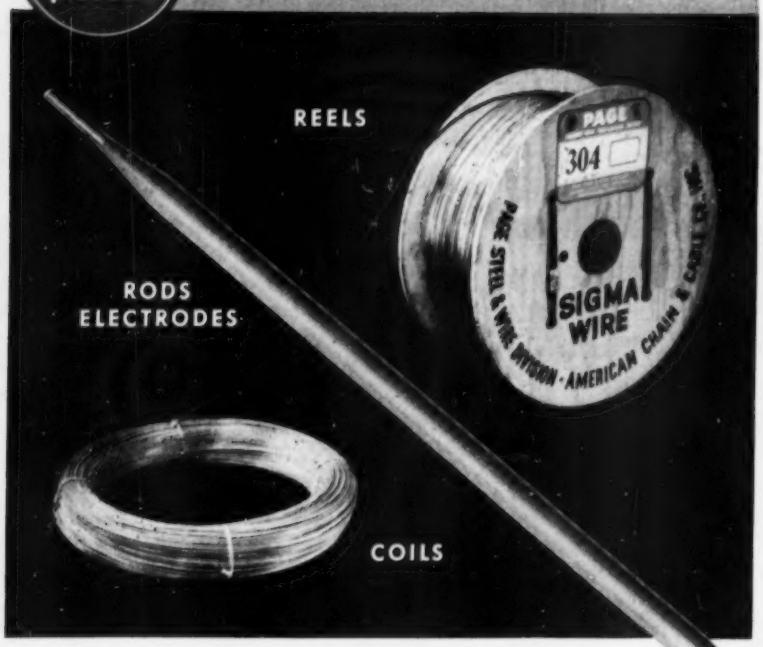
FRUEHAUF Trailers
"ENGINEERED TRANSPORTATION"

AEROVANS | CHASSIS | POWDER HAUL VANS | STAKE AND RACK TRAILERS | CHEMICAL TRANSPORTS

TRUCK-TRAILERS FOR EVERY CIVIL AND DEFENSE NEED!

ACCO products for Stainless Steel WELDING



How Do You Buy It?

• No matter how you buy stainless steel welding wire—on reels, in coils, or packages of rods or electrodes—PAGE can supply you in a variety of analyses.

AC-DC Electrodes—Gas Welding Rods

Stable burning even at lower heats. Slag is clean and easily removed. Coating resists cracking right down to short stubs. Your choice from a complete line for every type of stainless welding.

for Inert Gas Welding

Six Page-Allegheny stainless grades in .035″, .045″, and .0625″ diameters. Precision thread-wound on 25-lb. non-returnable reels to fit popular arc welding machines.

for Submerged Arc Welding

PAGE stainless in wire diameters from 1/32″ to 5/16″, plain or copper coated. In layer-wound coils, 22″ or 24″ mill coils, or 200-lb. returnable steel reels.

Write our Monessen, Pennsylvania office for literature and prices

ACCO

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PAGE Welding Electrodes Rods Wire

NEW DEVELOPMENTS

JET TEST CENTER

Plans for the U.S. Air Force's new jet test center at Palmdale, Calif.—where Lockheed Aircraft Corporation now flight-tests its F-94C Starfire jet interceptors—moved ahead when Lockheed signed a $477,516 contract for design of expanded runways, lighting, roads, and allied facilities. Palmdale's proximity to remote desert regions enables the all-rocket-armed, highly automatic F-94C, capable of speeds "exceeding 600 miles an hour," to be test-flown under ideal weather conditions, far from populated areas.

DURABLE SHOCK ABSORBER

A new, sturdier, and longer-lived shock absorber, which already has brought smoother, steadier riding to railway cars, has been adopted by the U. S. Army Ordnance Corps for its new Patton 48 tank. The tank shock absorber, or snubber as it is called, is a unit originally

Installing new snubbers on a tank.

designed and developed by Chrysler Corporation engineers.

The tank or railway car snubber depends upon friction of a brake lining type of material, pressing against the inside surfaces of its steel tube, to provide a constant snubbing action. This does away with the greater complication of hydraulic shock absorbers and the problem, when used in railway or tank service, of their varying rates of snubbing action. The new snubber reduces the pitch of the tank under gun firing recoil to a greater extent than any hydraulic type. This insures greater accuracy and requires less reaiming of the gun during firing.

FROZEN ARMOR PLATE

Cold metal is taking the place of hot steel as Army research experts substitute frozen metal bars for enemy tanks at the Watertown Arsenal, Mass.

Slabs of metal, frozen at temperatures as low as minus 455 degrees Fahrenheit, are being broken in a "deep freeze"

SELF-DEFENSE against the elements

A TROPICAL storm at its height is a terrible, awesome thing: winds toss trees around like tenpins, roofs leave houses almost as if they were built to do so, anything not nailed down takes off as if propelled by some mysterious inner force. Not to be outdone rain drives across and into everything, and during it all lightning crackles like an angry concert master directing the symphony of destruction. But elsewhere, safely sheltered against the would-be man-killer, are the men, women and children of the area—*safe because the Chrysler Siren sent a warning roar in every direction.*

The Chrysler Siren is built to give this kind of protection for years . . . base, housing and horn are constructed of cast iron and heavy gauge steel. Even the bearings upon which the turntable rotates are sealed in where dirt can't score and damage. And while it takes the miracle of utility power for remote-controlling one or a series of Chrysler Sirens, each can also be operated manually independent of any power save its own 180 horsepower Chrysler V-8 Industrial Engine.

In test after test, city officials, civil defense authorities, those charged with our security have found that there is no warning device that compares with the Chrysler Siren for strength of signal, for adaptability and—because of its tremendous power—for economy. Has the Chrysler Siren been demonstrated in your community? If not, call or write, ***Dept. 37, Siren Layout Service Industrial Engine Division, Chrysler Corporation, Trenton, Michigan.***

CHRYSLER

AIR RAID SIREN

Defense is a vital need, shared by all. Join and assist the Civil Defense group in your area.

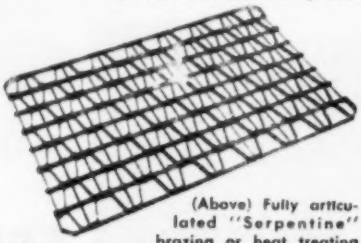
ROLOCK
FABRICATED ALLOYS

WHY FABRICATED?

All Rolock heat treating equipment is fabricated . . . not cast. Every carrier is job-engineered for the specific use and made from the correct metals and alloys for maximum resistance to all conditions of exposure, shock and abrasion. Especially successful are Rolock applications of nickel alloys . . . replacing heavy castings with durable, lighter weight fabrications. The examples shown below, while custom-built, can be adapted to your needs. We welcome your requests to solve your heat treating equipment problems.

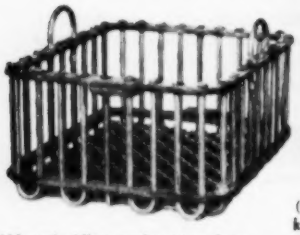
(Above) Stainless drop-bottom pit furnace basket for quality, uniform heat treat. Saves seconds between heat and quench.

(Above) Rugged assembly for carburizing shafts in pusher furnace. Adjustable posts position fabricated alloy screens; mesh to suit work. Light weight, high pay load, long life.



(Above) Fully articulated "Serpentine" brazing or heat treating tray, retains shape. Heavy or light, any width, length, depth. Many uses at lowest hourly cost.

(Below) Sectional lift post carburizing fixture. Most versatile for handling variety of parts. Each loaded grid quenched separately, if desired.



(Above) Alloy carburizing basket. Loose joints expand under heat. Rugged, flexible construction resists abuse.

(Right) Inconel basket assembly for nitriding. Only required baskets need be used for less than capacity operation . . . reducing furnace load.

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method of testing to find out whether they can withstand the hot steel of an armor-piercing shell.

To freeze metals at this incredibly low temperature, arsenal and near-by engineers designed a machine capable of hitting a new low. Inside this deep freeze the engineers placed a device to break the frozen metal bar. As the frozen metal breaks, attached recording instruments measure the toughness of the metal. Differences in temperatures at which the bars break indicate the velocities that would be required by armor-piercing shells to achieve the same effect.

PARACHUTE BRAKE

First details of parachute-brake research which resulted in the F-94C Starfire becoming the first production fighter-type plane equipped with a deceleration chute were released recently. Studies show that the type of nylon chute finally adopted for the F-94C jet interceptor provides

Starfire jet plane releases parachute.

marked economies in tires, brakes, and landing-gear maintenance as well as enabling the 600-m.p.h. plane to land in almost half the distance that would be necessary without the extra deceleration device.

Evidence of the chute's efficiency and economy came in Air Force tests in which forty-four consecutive landings were made with one aircraft without the use of brakes except for taxi turns and ramp stops. Statistics compiled by Lockheed engineers indicate that tire and brake life will be approximately doubled with one hundred per cent chute utilization and average runway conditions. In addition to saving wear on vital parts, landing distance can be reduced by forty per cent through use of the chute.

AIR SAFETY AIDS

The Navy has disclosed three new developments in the flight safety equipment field which greatly increase pilot safety, comfort, and efficiency. They include an integrated flight suit, a new type "thin-back" parachute, and an ejection seat mated to the other two developments.

Adaptation of the integrated suit to the new seat is based on combined Douglas Aircraft Company and Navy research and development. For fast ejections, it in-

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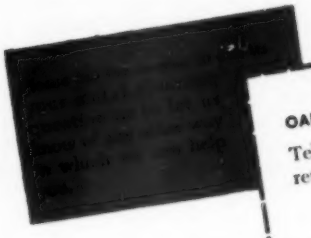
- ☐ Steam-detergent cleaning
- ☐ Barrel cleaning
- ☐ Burnishing
- ☐ Rust prevention
- ☐ Treating wash water in paint spray booths
- ☐ Cooling and lubricating for machining and grinding



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* Exposed bearing surfaces cadmium plated. Stainless steel external seal plates.
* Pre-lubricated—outer race grooved and drilled for easy relubrication.
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Aircraft Bearings

New Developments

corporates a single-point release mechanism which automatically releases shoulder straps, seat belt, anti-G hook-in, and cuts off the regular oxygen supply.

The thin-back parachute, developed by the Switlik Parachute Company, is opened and closed with a chain fastener arrangement (similar to a zipper) in lieu of the familiar cone and pin. The Navy said the new pack is only one-third as thick as the present chute, requires only one man for packing, thereby cutting packing time in half, is much more comfortable, and is twelve pounds lighter than the present standard chute.

JEEP LITTER RACK

A litter rack has been developed which can be mounted over the hood of the M38 jeep, permitting the simultaneous

Jeep equipped with 4-patient litters.

transportation of four litter cases. The rack can be mounted with the windshield in position or off the jeep and can be folded back while in place to allow access to the engine.

MAKING PURE SILICON

Development of a process for manufacturing pure silicon, which may lead the way to more powerful and less bulky television, radio, and other electronic and electrical equipment, was disclosed recently by the Du Pont Company. By this process the company has opened up a virtually unlimited source of the material —a nonmetallic element—for transistors, which appear to be revolutioni ing electronics, as well as for rectifiers and probably other electrical parts. Silicon is expected to greatly broaden the scope of these developments because it works over a much wider temperature range than other materials available.

MOBILE PETROLEUM LAB

The Army Quartermaster Corps' compact new mobile petroleum laboratory recently undertook a cross-country tour to augment training of industry-sponsored QMC petroleum laboratory Army Reserve units of the Nation's major oil companies. The semitrailer, which can be transported by air, is designed for combat-area testing of petroleum fuels and lubricants. This work includes identification and salvaging of captured enemy fuel and other stores of gasoline, fuel

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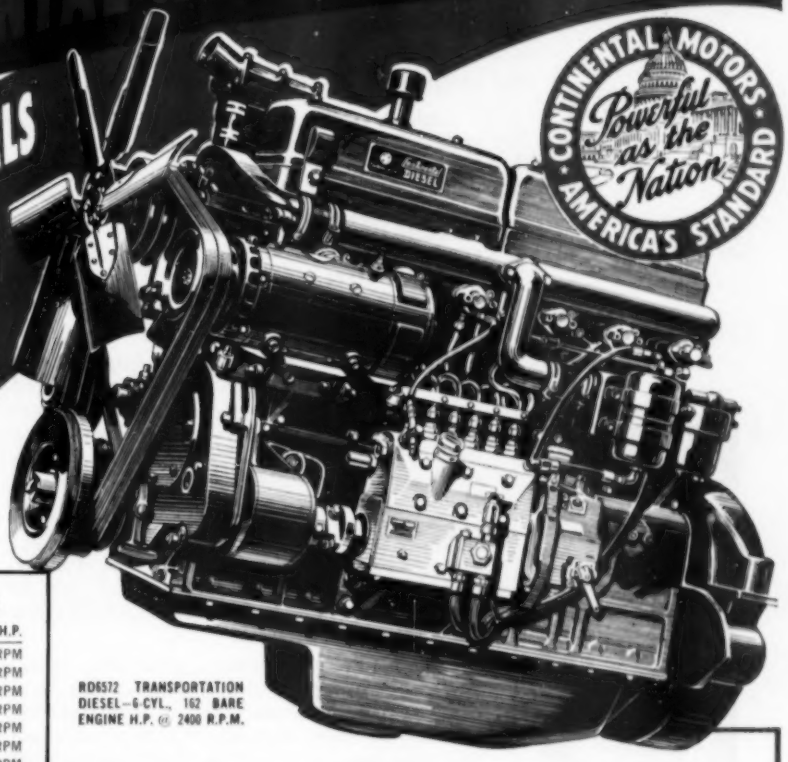
WITH CONTINENTAL RED SEAL POWER

28 BASIC MODELS FOR TRUCKS AND BUSES



RD6572 TRANSPORTATION DIESEL—6 CYL., 162 BARE ENGINE H.P. @ 2400 R.P.M.

TRANSPORTATION GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N4062	4	2⅛	3½	62	26 @ 3400 RPM
Y4069	4	2½	3½	69	28 @ 3400 RPM
Y4091	4	2⅛	3½	91	36 @ 3400 RPM
F4124	4	3	4½	124	47 @ 3200 RPM
F4140	4	3 3/16	4½	140	52 @ 3200 RPM
F4162	4	3⅞	4½	162	58 @ 3200 RPM
F6186	6	3	4½	186	77 @ 3500 RPM
F6209	6	3 3/16	4½	209	90 @ 3500 RPM
F6226	6	3 5/16	4½	226	99 @ 3500 RPM
M6271	6	3⅛	4½	271	97 @ 3000 RPM
M6290	6	3¼	4½	290	108 @ 3000 RPM
M6330	6	4	4½	330	125 @ 3000 RPM
K6271	6	3⅛	4½	271	115 @ 3200 RPM
K6290	6	3¼	4½	290	123 @ 3200 RPM
K6330	6	4	4½	330	145 @ 3200 RPM
B6371	6	4⅛	4½	371	124 @ 3000 RPM
B6427	6	4 5/16	4½	427	142 @ 3000 RPM
T6371	6	4⅛	4¼	371	144 @ 3000 RPM
T6427	6	4¼	4½	427	170 @ 3000 RPM
U6501	6	4½	5¼	501	178 @ 2600 RPM
R6513	6	4½	5⅛	513	180 @ 2800 RPM
R6572	6	4¼	5⅛	572	200 @ 2800 RPM
R6602	6	4⅛	5⅛	602	212 @ 2800 RPM
S6749	6	5⅛	5½	749	250 @ 2800 RPM
S6820	6	5⅛	5½	820	275 @ 2800 RPM

TRANSPORTATION DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
TD6427	6	4 5/16	4⅛	427	116 @ 2400 RPM
RD6572	6	4¼	5⅛	572	162 @ 2400 RPM
SD6802	6	5 1/16	5½	802	217 @ 2200 RPM

When you choose a vehicle powered by Continental Red Seal engine, you tap a reservoir of experience unsurpassed in the engine-building field. Continental, and Continental only, delivers the balanced combination of power, economy, dependability and long life resulting from all these features—an array found nowhere else:

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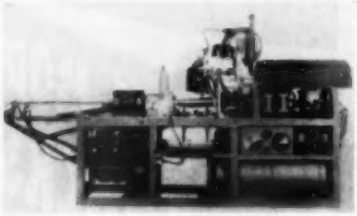
235

New Developments

oils, lubricating oils and greases which must be accurately classified before they can be used.

PROJECTILE WELDING

A universal welding machine for projectiles has been recently developed by the Morley Machinery Corporation of Rochester, N. Y. It makes use of a standard welding head which uses a continuously consumable electrode. This



The universal welding machine.

head can be easily adjusted with respect to the shell.

A diversity of rotating bands can be applied by either a spiral or index feed of the head while the shell is rotated between self-centering chucking adapters. Complete versatility of speeds and feeds is provided. The welding generator is incorporated in the frame of the machine making it an all-inclusive unit. Automatic loading and unloading, after each shell is processed, makes the machine suitable for production-line work.

HYDROFOIL BOATS

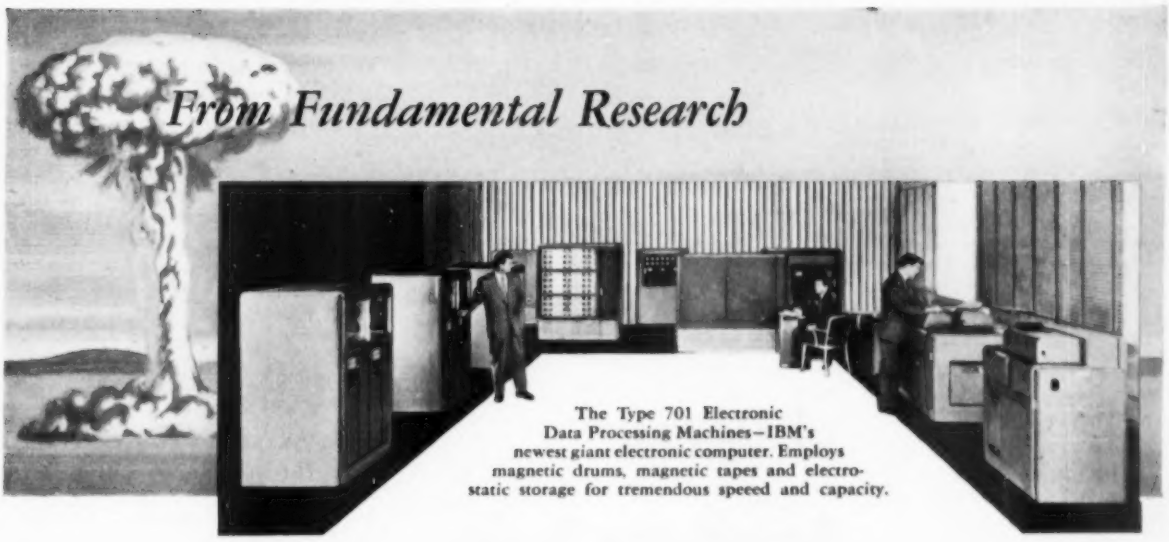
Hydrofoil boats of two types are undergoing experiment and evaluation by the Navy, and tests of the craft are being conducted by the Bureau of Ships. Hydrofoils are "underwater wings" installed on the bottom of small craft. With these wings the boat can be supported in water in the same manner as an aircraft is supported in air. When sufficient speed is reached the hull lifts from the water and the boat is entirely supported by the hydrofoils.

When the hull is out of water and the boat is riding on the hydrofoils less water friction results and higher speeds can be attained. Because of water resistance to hydrofoils before lifting speed is reached, boats of this type require greater power at slow speeds than conventional types.

JET LUBRICANT

A synthetic jet-engine lubricant, required to meet the needs of the new high-power jet aircraft, was announced recently by the Standard Oil Development Company. The new-type lubricant was developed by this company and its affiliated research laboratories in England.

From Fundamental Research



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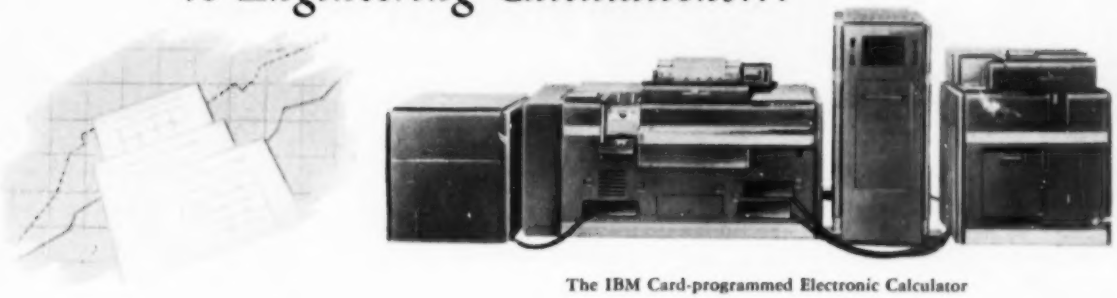

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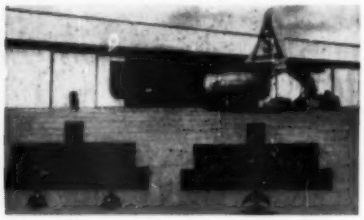
New Developments

MASSIVE BULLDOZER

A massive, versatile bulldozer tractor, designed to tow a 65,000-pound load at 25 miles an hour, has been procured for tests under the supervision of the Corps of Engineers. The tests are being conducted at Fort Belvoir, Va. The vehicle is designed to level ground quickly and to tow heavy artillery pieces. It has been dubbed the "Bull Moose," by the manufacturer. The machine is 11 feet, 7½ inches high, 22 feet, 9 inches long, and weighs 51,300 pounds with attachments. The dozer blade is 11 feet wide and 4 feet high.

NEW WING HANGAR

A newly designed wing hangar will soon enable the United States Air Force to provide a closed facility in which to service its medium and heavy aircraft



New wing hangar with insets showing accommodations for regular and swept-wing heavy and medium bombers.

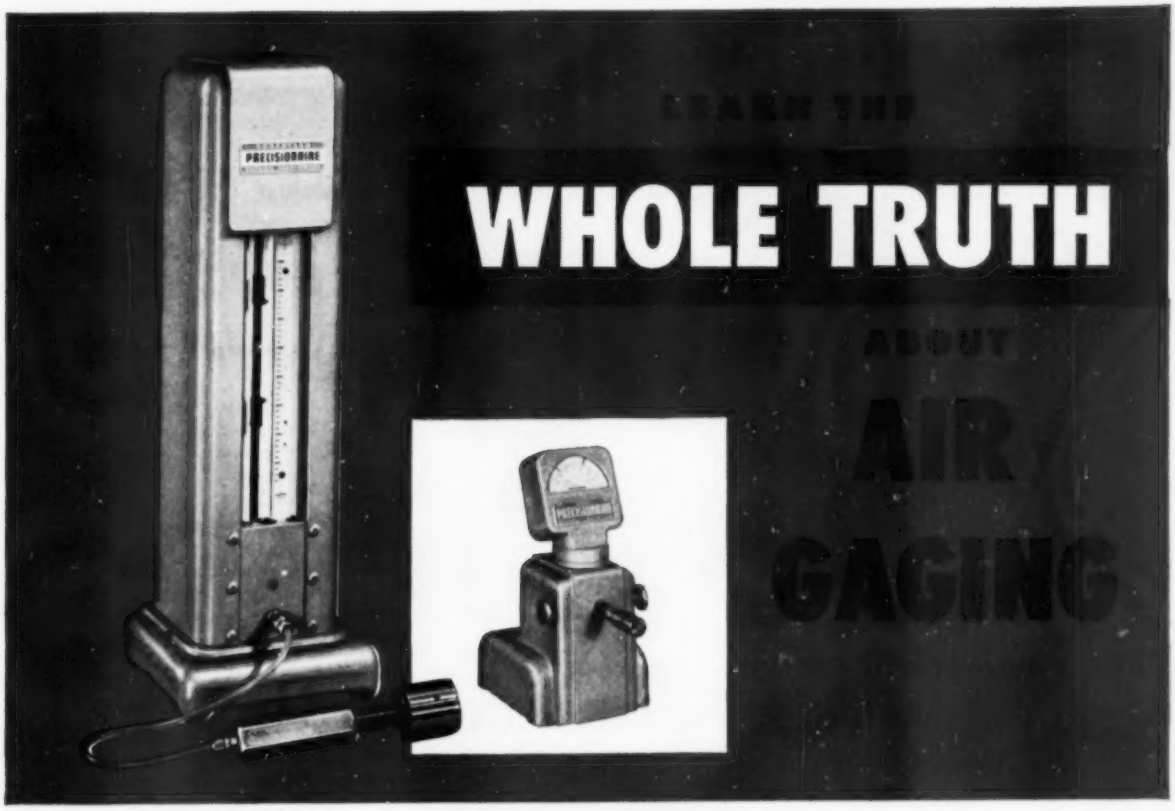
in any kind of weather. The Luria Engineering Company has prepared from Air Force criteria, plans and specifications for a multipurpose wing hangar which is the Air Force standard for future construction of service hangars in cold climates for medium and heavy bomber and transport aircraft.

TIME MICROSCOPE

A "time microscope" has been developed by the Naval Research Laboratory of the Office of Naval Research which permits observation and photography of a voltage change as great as three million volts a second. This corresponds to a trace velocity on the cathode-ray screen of 13,000 inches in a millionth of a second—faster than the free-space speed of light.

SOLAR ENERGY CONFERENCE

The National Science Foundation recently announced a grant of $6,000 to the University of Wisconsin, Madison, for joint support of a scientific conference on solar energy and its utilization to be held September 12 to 14, 1953. The conference will bring together about thirty physical scientists and engineers from the United States and abroad to assess present knowledge of solar-energy utilization and to point out needed areas for



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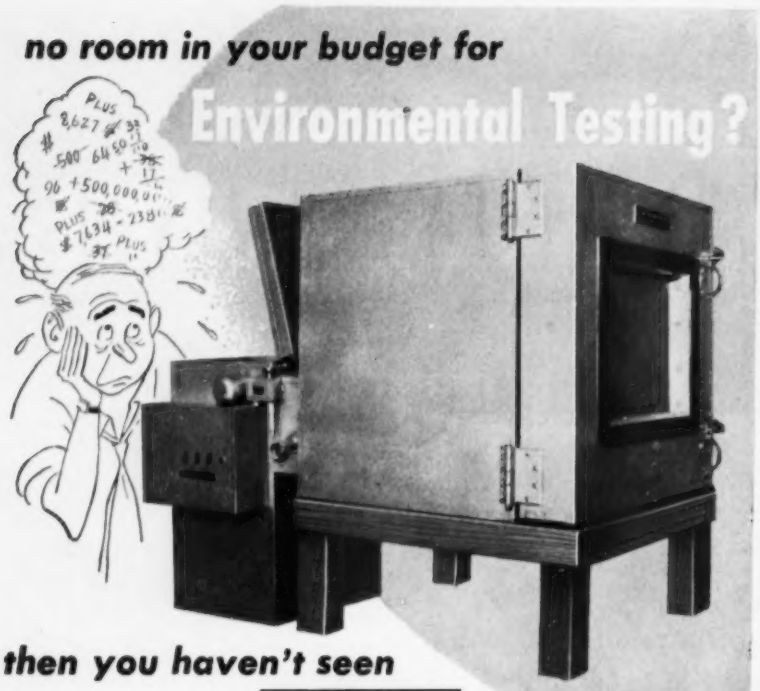

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The Tenney Servo Unit, a portable air-conditioning system, provides broad variations of heat, cold, and/or humidity for aging and weathering test programs. Air is circulated at the rate of 40 cu. ft. per min., capable of absorbing 1700 B. T. U. per hour at − 100°F., or of delivering 5000 B. T. U. heating effect at a maximum temperature of + 185°F. Relative humidity can be maintained from ambient to 95% in a temperature range of ambient to + 180°F. in 40 cu. ft. of recirculated air. Low temperature operation requires 10 lb. of dry ice per hour at − 180°F., ¾lb. per hour static.

SPECIFICATIONS

Model	Size	Wgt.	Dry Ice Capacity	Total Temp. Range	Electric Req'mts.
TSU-50	17"x17"x31"	165 lb	50-70 lb.	−100°F. to +200°F.	2 kw.
TSU-150	21"x25"x33"	200 lb.	150 lb.	−100°F. to +200°F.	2 kw.

The Tenney Companion Test Chamber provides an efficient test work-space when attached to the Tenney Servo Unit either horizontally or vertically, by a simple, sturdy device. (Servo is easily detached for use with other enclosures or tests.) Ruggedly constructed and fully insulated, this chamber is built in three sizes of work space, stainless-steel lined: 3 cu. ft. (18" x 18" x 18"), 8 cu. ft. (24" x 24" x 24"), and 27 cu. ft. (36" x 36" x 36"). Forged brass hardware is provided. Complete vapor-proofing is achieved by special gaskets. Optional equipment includes multi-paned viewing window in door, electrical connector panel, turning shafts, coaxial cable, utility ports, and high-voltage terminals.

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basic research in the physical and engineering sciences. In this way it is believed that additional research in the field will be stimulated.

The world's energy supply from fossil fuels, such as coal, oil, and natural gas, is limited and in some regions nonexistent. Effective conversion of solar energy into readily usable forms of heat, light, and power would solve the problem of diminishing fuels for an indefinite period.

FASTER PRODUCTION

Production of T-33's, the international jet trainer, will roll at a faster clip—and with reduced assembly cost—through installation of a mechanized final assembly line at Lockheed Aircraft Corporation's plant in Van Nuys, Calif. Conversion of the present manual-move system to a nonstop operation will make possible accelerated output by the final assembly line. It is estimated that the mechanized line will cut final assembly time by approximately twenty-five hours per airplane.

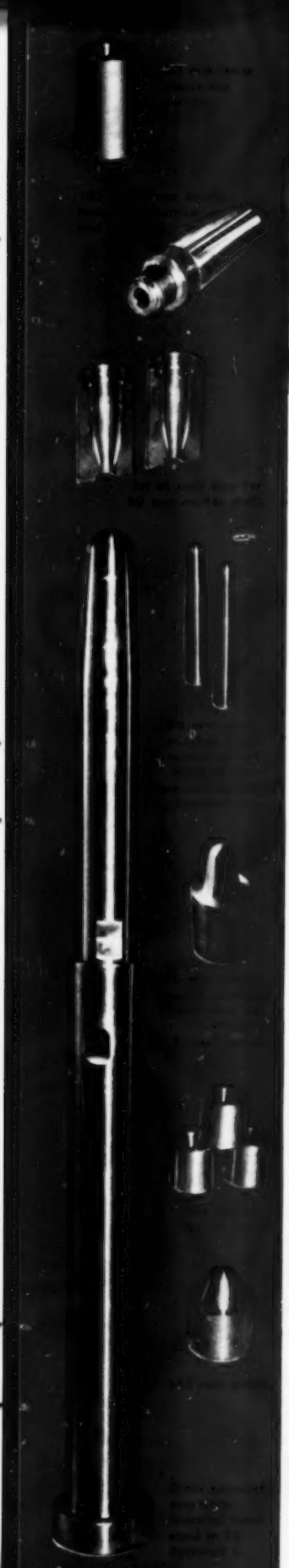
TOOL LIFE DOUBLED

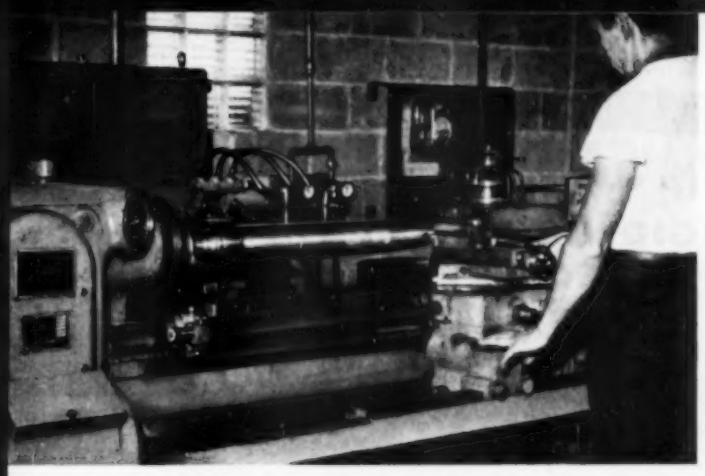
A 3-step tool-grinding method that cuts grinding costs by one-third while increasing tool life up to 600 per cent over that of conventional wet or dry grinding was announced recently by the Metalloid Corporation, Huntington, Ind. Exhaustively field tested in some of industry's largest plants, the new method of grinding is reported to preserve the true hardness and metallurgical properties of the metal at and below the surface of the cutting edge of the tool by limiting the heat generated by grinding. The 3-step method involves the use of a special grinding fluid, a mist applicator, and a fine-grain, soft-bond wheel which roughs and finish grinds in the same operation.

SHOES X-RAYED

Convinced that fluoroscopic X-ray offers the best answer to the problem of disclosing hidden and latent defects in military footwear, the Quartermaster Inspection Service of the New York Quartermaster Procurement Agency, has acquired twenty special wheel-mounted fluoroscopic units from the X-ray department of the General Electric Company.

The new units offer considerable promise for application in such fields as the manufacture of rubber, electrical, light-metal, plastic, and wood products. The units are now being placed in the plants of various footwear manufacturers throughout the country, where they are being used by Quartermaster Corps inspectors as final inspection tools. They can also be used to trouble-shoot at any spot along the production line and to educate workmen in correct fabrication and assembly methods and procedures.

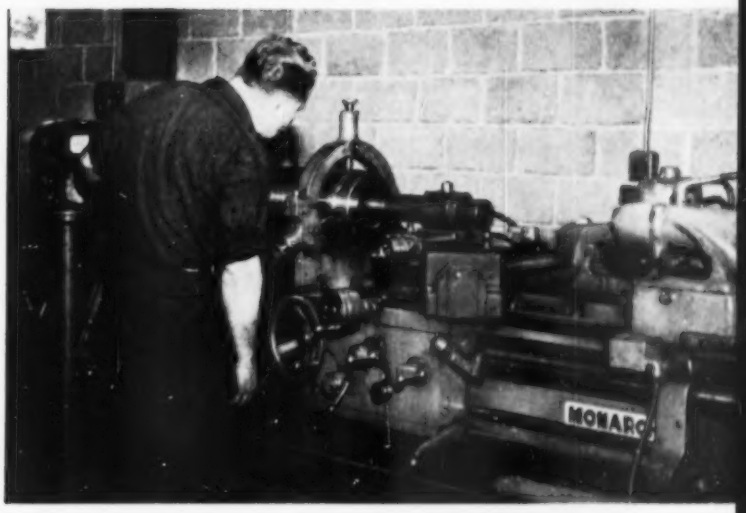




Rough turning draw and pierce mandrels on the Mona-Matic. Sizes include 90, 105 and 120 mm shell. Material is hot work die steel. Billets often weigh up to 210 lbs. Depth of roughing cut is up to ½" on side representing a saving of 3 hours per piece over conventional engine lathe procedure. Finishing cut is taken after heat treatment.

Monarch Air-Gage Tracer Scores

GRAND SLAMMO ON THE AMMO



Contour boring die liners on a Series 60 using a 30" long boring bar. Material is a forged hot work die steel billet 10" O.D. x 20" long. Total tolerance held is .002" to .003". The "Air-Gage Tracer" method saves up to 6 hours per piece.

Just put these two facts together. **(1)** More hot forged tooling for the shell program is produced by the Diversey Engineering Co. (Franklin Park, Illinois) than by any other plant. **(2)** The turning equipment is exclusively Monarch, with every machine — Mona-Matics, Series 60's, and Heavy Duty lathes — Air-Gage Tracer controlled. Some of these are swiveling types with Auto Cycle Unit. Here, more of these lathes than in any other shop doing similar work, produce on a 24-hour-a-day, 7-day-a-week schedule.

Significance? This equipment delivers a 200% increase in production compared with less modern methods generally employed. Its dependability is such that no shell line in the country depending on Diversey hot forged tooling has failed to keep moving.

This manufacturer currently has on order 6 additional machines—all sold by the performance of present equipment. Why not take a tip from Diversey and load up with production ammunition like this for yourself? Just fire us a request for our complete Air-Gage Tracer Booklet No. 2606 . . . *The Monarch Machine Tool Co., Sidney, Ohio.*

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COMMUNICATIONS

SATELLITE PRACTICAL?

THE EDITORS.—Dr. von Braun has made a large contribution toward the furtherance of orbital flight with his recent efforts in the design and construction of a satellite vehicle. The following comments are offered in the belief that such enthusiasm is more effective when tempered with restrained caution.

There can be no doubt as to the feasibility of this project nor is there any possible question of Dr. von Braun's competence in the field. The development of the V-2, whatever else it may have been, is certainly one of the most outstanding technical achievements in rocketry to date.

But it is wise to examine the objectives and the cost features of the proposed satellite-vehicle project with a jaundiced eye. With regard to objectives:

1. It is difficult to see why the satellite should be more of an ultimate deterrent against future war than was the atom bomb or any of the host of other "ultimate" weapons. We would certainly not regard it as such ourselves if we found that some one else had beat us to it.

2. No potential enemy would hesitate to call our bluff if, as Dr. von Braun proposes, we give them a "determined, power-packed 'No'" when they started space rocketry. And this Nation with its present ideologies (bless them) would not bomb in preventative action.

3. The space station would be not nearly as useful for monitoring enemy activities on the earth's surface as is supposed. There are about 55 million square miles of land area on the surface of the earth, perhaps 100 thousand of which would have to be kept under continual surveillance. To do so photographically, at a reduction of 1,000 to 1 would still mean a hundred square miles of negatives to be taken and thoroughly studied perhaps every few days.

4. The accuracy of missile guidance from a satellite appears questionable, as does the desirability of using a satellite as a launching site because of limitations in firepower and on the time of release. Guidance from a control station or with devices carried by the missile itself can be argued with some advantage and the economics appear more favorable.

5. Far from being invulnerable in flight, the satellite is a sitting duck, incapable even of evasive maneuvers.

With regard to cost, I have heard others in the field estimate the price of placing a lace handkerchief in orbit at 50 billion dollars. While this, too, may be an exaggeration, Dr. von Braun's project calls for structure, mechanism, equipment,

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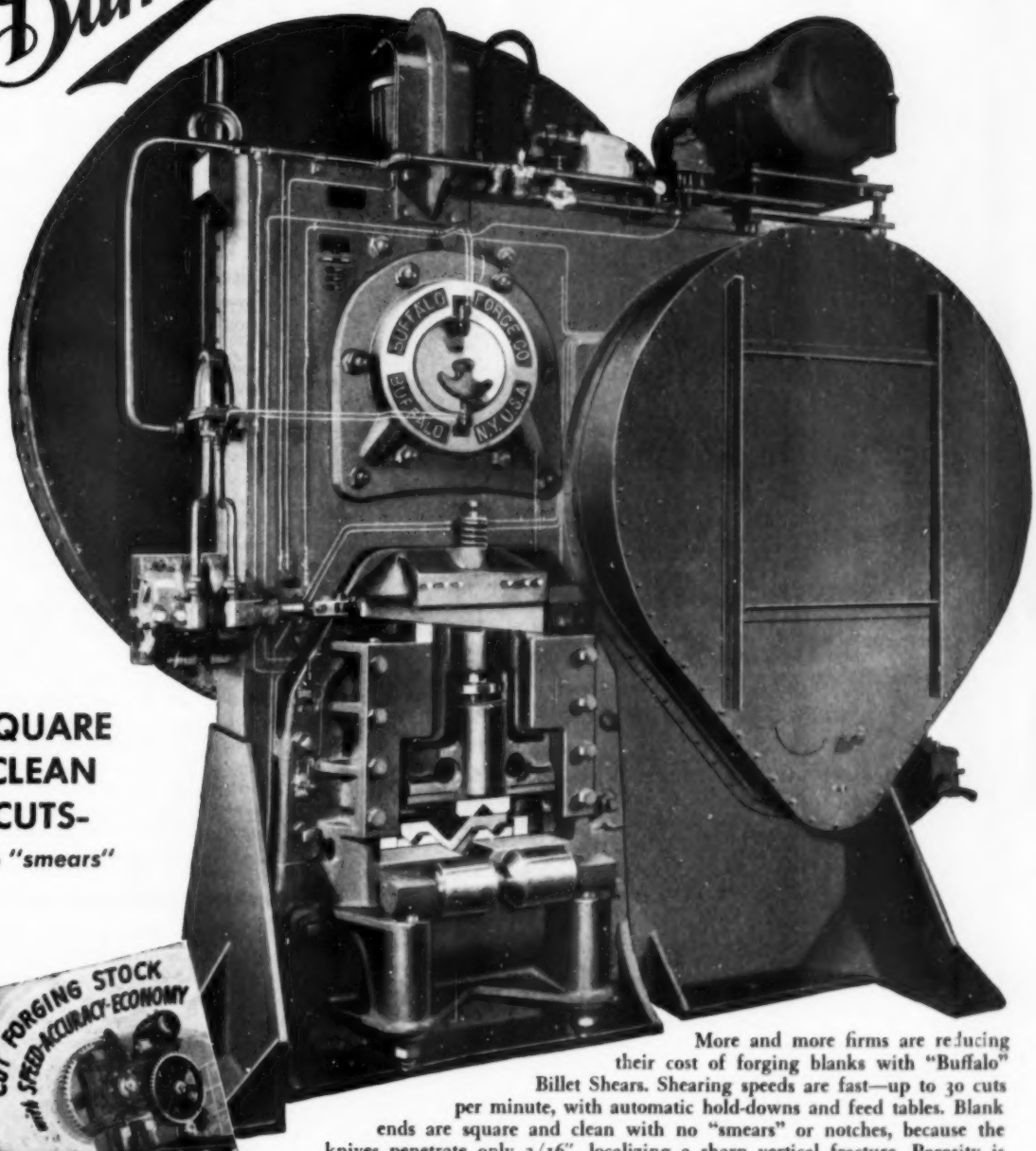

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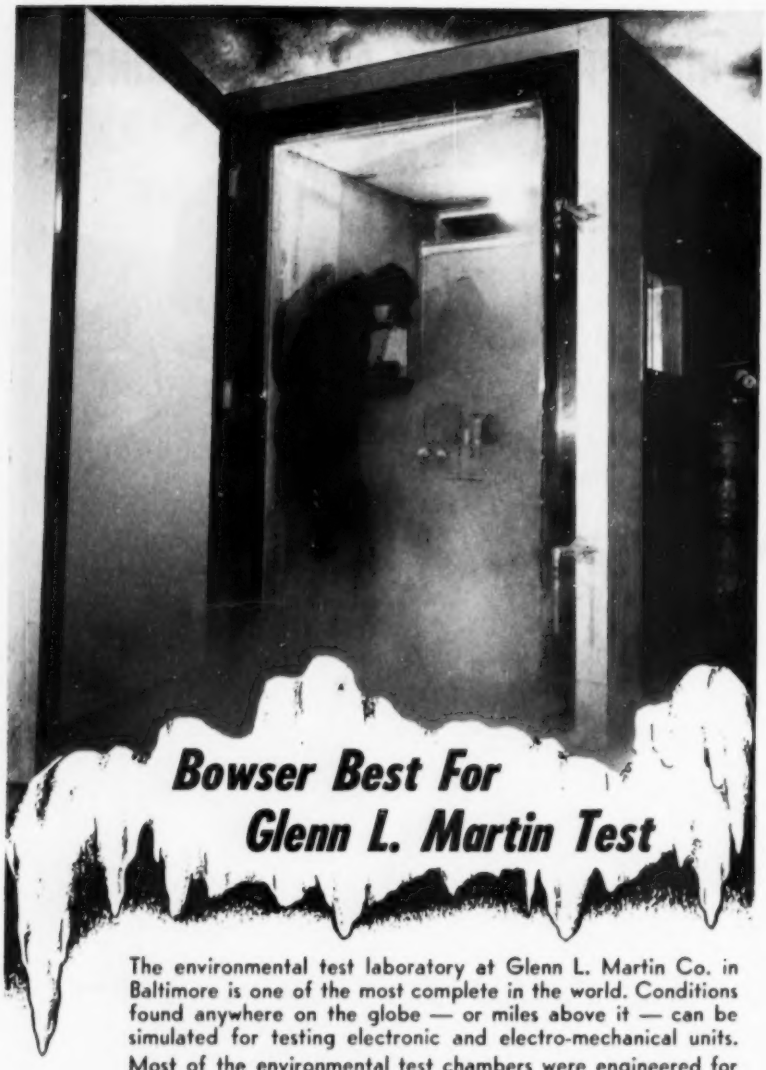

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and instrumentation to fulfill a mission considerably more difficult than that of any aircraft yet placed in production.

Yet, while such commonplace devices as the B-36 and the B-52 may cost from twenty to fifty dollars a pound for the empty vehicle, the estimated cost of the satellite project has been based on a figure of two dollars a pound for the empty vehicle. The total budget of 4 billion dollars seems extremely optimistic.

P. E. SANDORFF

Cambridge, Mass.

■ **In his article, "Space Superiority," published in the March-April 1953 issue of ORDNANCE, Dr. von Braun wrote:**

"I would not be surprised if a good many readers were to consider the building of enormous, man-carrying space vessels and using them to set up a space station as somewhat on the risky side—maybe you would even call it fantastic. But let me assure you that we who advocate it are faced with far fewer basic problems that were the men who undertook the atom-bomb development back in 1940!

"I am not claiming, mind you, that building a space station is as simple as putting a new automobile, or even a new jet aircraft engine into production. It is far more than that—it is one of the greatest engineering problems of the age. We must expect many a setback and many a heartbreak, but setbacks and heartbreaks are part and parcel of any courageous, far-sighted engineering effort."

MODERN THERMOPYLAES

THE EDITORS.—Recently I took a trip to Indo-China where the French are fighting a costly and endless war against the rebels.

While there I motored almost the entire length of the peninsula from Saigon to Siem Reap, the site of the ruins at Anchor Wat. Enroute we were halted for six hours to allow a single platoon of French soldiers and their trucks to cross the wide Mekong River on a miserable little ferry which plys wheezingly from bank to bank.

Right there I formed the opinion that the French never could win the war until roads, bridges, and other strategic lines of communication were first built.

It was at Thermopylae centuries ago that a few Greeks held back hordes of Persians because the narrow pass allowed only a few of the greatly superior Persian enemy to come to grips with the Greeks at one time. Evidently our Army has learned little from that lesson.

FAIRCHILD POWER for the RYAN FIREBEE

JET POWER to send a remote-controlled, high-altitude missile streaking across the sky at near-sonic speeds called for a new concept in powerplant design.

Fairchild met the challenge with the J-44 turbojet engine. It had to be extremely compact—yet provide more thrust than any engine of its size ever developed. It had to be expendable for warfare—yet quality-built for frequent re-use in research and training after parachute recovery.

In one application recently revealed, Fairchild's J-44 provides the power for the Firebee, a target drone with fighter plane performance, made by the Ryan Aeronautical Company.

TIME WILL TELL of the expanding role in the nation's guided missiles program, in light aircraft and as a supplementary powerplant in large aircraft of this engine concept that *had to be different* . . . another example of the design, development and production facilities of Fairchild fulfilling specialized power requirements.

J-44 SPECIFICATIONS

Announced thrust	*1000 lbs*
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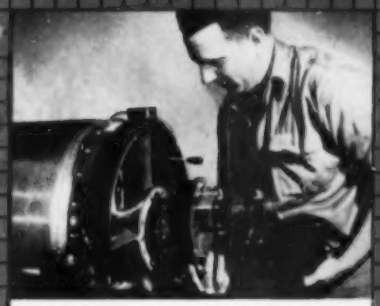

ACCESSORY SECTION containing essential controls, is quickly removed and replaced without special tools.

ONLY 72 INCHES LONG and weighing 300 pounds, the J-44 has varied applications in the nation's guided missiles program as well as in piloted aircraft.

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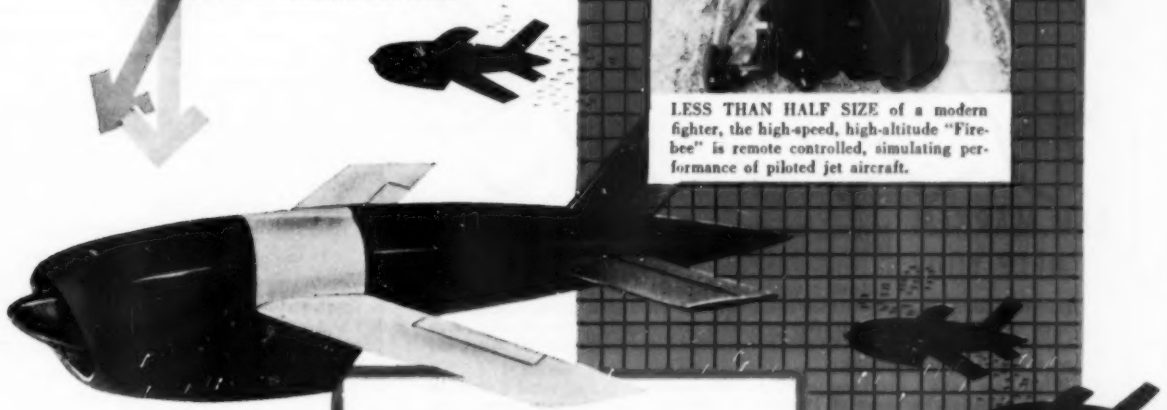

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Communications

The Navy's road system is the boundless sea, but it develops its far-flung bases simultaneously with its vessel-building program and sees to it that these bases are large enough to accommodate the huge new carriers now being built. Without these bases the value of the carriers and other vessels would be nil.

The Air Force uses the air as its road system but spends huge sums in building airports at strategic points of sufficient size to allow the employment of our modern jets.

Not so with the Army. It is spending all its money on troops and weapons, seemingly oblivious of the fact that the roads, ports, and bridges by which they might be employed to advantage are practically nonexistent.

In Indo-China, the French, regardless of their great superiority in modern weapons, are prevented from bringing them into play against a very primitive enemy who can step through the jungles and defeat small, isolated French forces in detail.

We are supplying the French with weapons at a cost to us of hundreds of millions, but I saw no evidence that the necessary roads and bridges are being built to employ them effectively.

What is needed in Malaya, Indo-China, India, and other countries awaiting modern development is the planning and building immediately of modern systems of strategic lines of communication to be available in time of war against a possible enemy and in time of peace to allow modern culture to penetrate into the dark places.

There is no use shipping thousands of guns, tanks, and other tools to those countries which are modern Thermopylaes and where a few determined men can hold back potentially stronger forces.

The Army must wake up to the fact that lines of communication are not secondary to modern weapons but are an integral part of them—just as vital as fuel and ammunition. Modern machines make road building a simple operation.

In my opinion strategic roads are the secret weapon by which the French can win in Indo-China, the English in Malaya, and, if properly planned and promptly built, they can prevent wars in countries at present ripe for revolution.

HAROLD L. MACK

Carmel, Calif.

■ **The United States Army with its Corps of Engineers and the Navy with its Construction Battalions did a splendid job of keeping our lines of communications open during World War II.—THE EDITORS.**

Now, more than ever before, America must make full use of its steel-making capacity and conserve its natural resources. Now, more than ever, there is national significance in the phrases, *"Make a ton of sheet steel go farther"* and *"Make your product last longer."*

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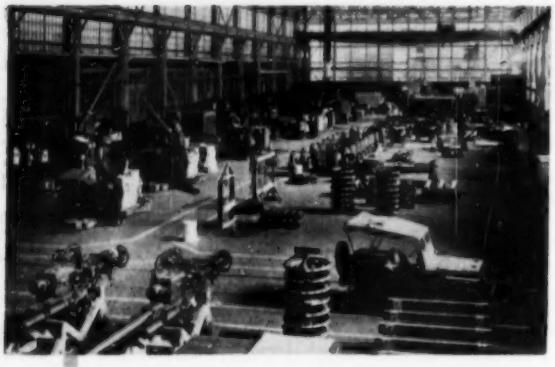
U. S. Ordnance and **Aetna-Standard** have worked hand in hand for the last decade on several important contracts. Recently, we completed a large production run on a jeep mount for a 105 MM recoilless rifle. We are busy on two other long-range contracts . . . one for an anti-aircraft gun and the other for an anti-tank gun. In addition to the production, Aetna-Standard assisted in the design and pilot models on both of these items. Below you see the big Ordnance assembly floor in Aetna's Ellwood City, Pa., plant.



The big assembly floor in the Ellwood City plant is the center of activity for Ordnance work.

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Book REVIEWS

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BRIG. GEN. THOMAS K. VINCENT, *artillerist, engineer, author, Redstone Arsenal, Huntsville, Ala.*

The River and the Gauntlet. By S. L. A. Marshall. New York: William Morrow & Company. 385 pp. $5.

IN this terse yet infinitely detailed account of the most surprising and perplexing defeat in America's military history the author makes use of a unique method of battle reporting. His technique is based upon many interviews with participants, from private to commander and staff.

Brig. Gen. S. L. A. Marshall is admirably equipped to write the story of America's longest retreat. He not only was a part of it, but for nearly a decade as field historian with the U. S. ground forces his studies of operations and of the use of weapons has built up a system of reporting which almost completely avoids employment of both afterthought and "official" documents.

The result, while not definitive military history, is most surely the basis on which factual history must be written. Meanwhile, the reader of today is there—no "dressed-up story" will ever pass as the truth!

Necessarily slow, the opening picture of the strategy of the campaign and the build-up or the action allows the reader to understand what otherwise would be but a series of unconnected encounters. The author's style allows for infinite detail without ever becoming tiresome or verbose, and he writes with a wealth of imagery.

General Marshall is never didactic in drawing final conclusions. In fact, very few are drawn, yet the analysis is presented, inherent in the story, for the conclusions of the thoughtful

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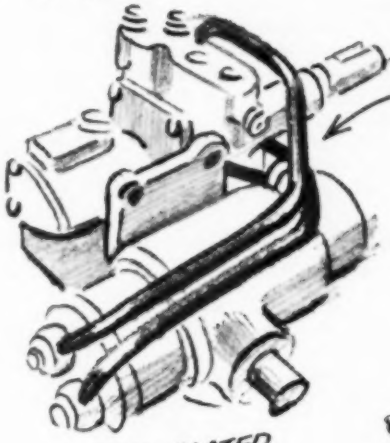

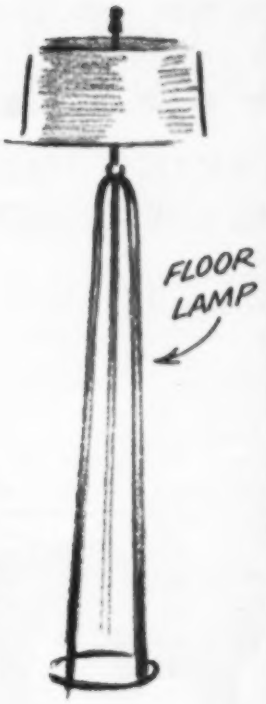

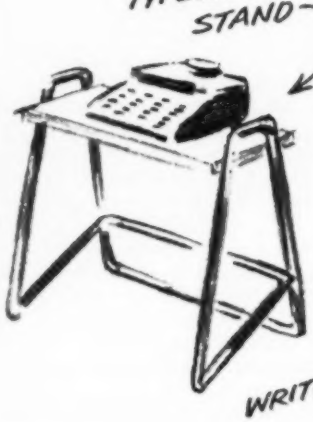

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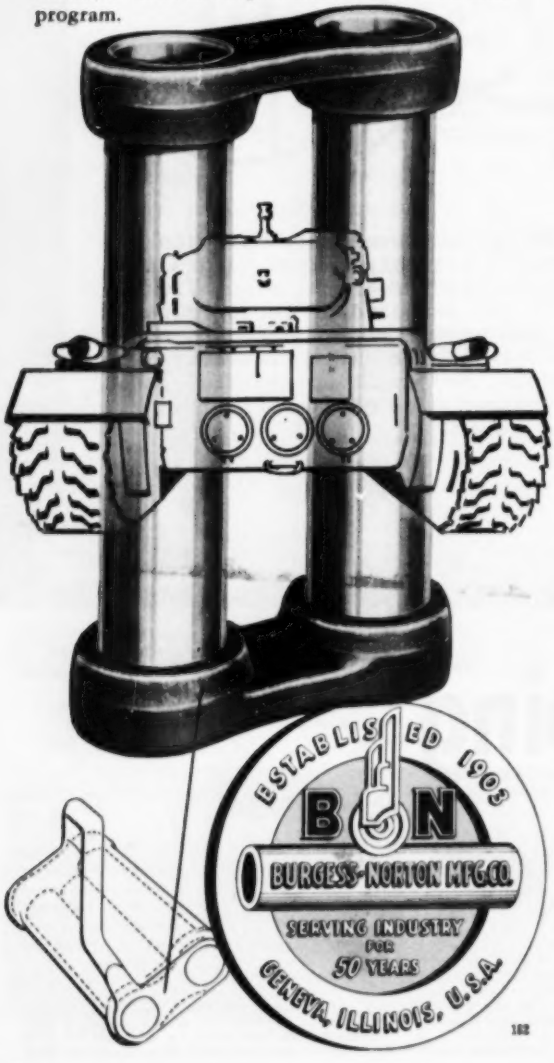

reader. By his technique of studying the stories of company after company, Marshall gets a cross check on all, and evolves final fact.

Following the body of the work is a "glossary of main weapons" consisting of line drawings and a short description of eleven of the common arms of the infantry combat team. It is unfortunate that two slips were permitted to pass editing. The famous 40-mm. automatic gun which was developed by Bofors Nobelkrut of Sweden is called "Boffers."

Much more serious is the statement used in describing the M1 (Garand) rifle—"A semiautomatic rifle, it fires as long as the trigger is pressed back."

All in all, this is a volume which should be missed by no thoughtful American and is surely a "must" for any student of modern warfare.—F. W. FOSTER GLEASON.

History of the German General Staff. By Walter Goerlitz. New York: Frederick A. Praeger, Inc. 508 pp. $7.50.

THIS volume probably can be best described by quoting from the preface by Walter Millis, military editor of the New York *Herald-Tribune:*

"It is at once rather more and perhaps somewhat less than its title suggests. The author's approach is not through the technics of organization or even of plan, but through the succession of great and near-great or sometimes inferior personalities who together . . . made up the story. . . . As such it is less a history of the General Staff, perhaps, than . . . of German generalship formed out of a long tradition of military service going back to Frederick's feudal armies yet carrying forward into the appalling moral dilemmas of Hitler's demonic state. About half of the whole book is devoted to the Second World War. . . ."

There you have it. If you wish to trace the evolution and functions of the German General Staff through a succession of organization charts, lay the book aside. After reading every word of it you will have only the haziest idea of what constituted that staff, or how it operated at any given period of its history.

But if you would enjoy a gripping account of leaders of German military thought and action from about 1640 to 1945, you have a delightful treat in store. The author's familiarity with every link in unnumbered chains of events studding World War II from beginning to end, a familiarity which would seem to derive from omniscience upon these matters, is uncanny to say the least.

How he could have gained this vast store of information without having personally interviewed all the prominent German actors in the tragedy, recording for future exposition their inmost thoughts, their hopes, their fears, their motivations, I cannot see. And yet the story unfolds so simply and compellingly that it is hard to believe that he is at any time substituting fancy for fact.

The volume, however, presents certain faults. As a serious work it should embody an adequate bibliography. None is present. Despite the fact that Goerlitz must have consulted countless sources, not one of them receives mention. His *dramatis personae* include various authors of works on the German and other general staffs, *e.g.*, Falkenhayn and Schellendorf, but they receive no credit for these contributions to the literature. Non-German authors of similar treatises such as Captain Derrecagaix (France), and Lieutenant Colonel Hittle (U.S.M.C.), are passed over in silence.

Additional criticism may be directed to the absence of an index to abbreviations, some of which are not easy to penetrate. And the direful lack of maps, of which a few could certainly have been included, leaves us without a clear picture of a number of operational situations that are discussed. Goerlitz is also shaky on some of his historical facts.

It was refreshing to this reviewer, an amateur military his-

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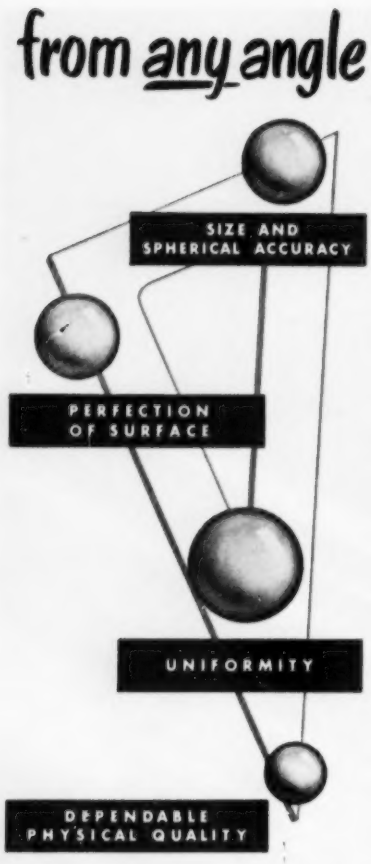

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Book Reviews

torian, to note how frequently the historical section of the German General Staff receives mention in this volume. Let us hope that the study of military history, which first received adequate recognition from the German States, will continue to enjoy among other general staffs the enhanced status which World War II appears to have conferred upon it.—CALVIN GODDARD.

The Amazing Mr. Doolittle. By Quentin Reynolds. New York: Appleton-Century-Crofts, Inc. 313 pp. $3.95.

THE most amazing thing is that a book of this kind is written about a living man. Saints are not called saints until after they are dead, and the likenesses of national heroes are not put on postage stamps until the persons have passed on. But the author is a writer who knows the feel of public opinion, and he has produced an intriguing biography of Lieut. Gen. Jimmy Doolittle that will not bring frowns from the many other living personalities who also had important parts in the amazing things accomplished.

In fact, he has given credit where credit is due, and the record of others is woven into the story. The book is really a story of events, the events that made the agonizing path through which a relatively few individuals in the military services and some far-seeing men in private industry made it possible for the United States to get into quick production of superior planes in World War II.

As an interesting adventure tale, the book is well worth reading. But military readers will find it a valuable text because it tells the story of the grueling uphill work of persistent under-officers in trying to get an effective high-speed fighting airplane against the cold lethargy of top brass and the penny-pinching economy of a Congress then disinterested in military preparedness.

The fight to get 100-octane gasoline, for example, was a struggle that took years of effort long after the technical phases were solved.

The book is to be recommended as a text for study for all officers interested in preparing for the next war rather than in planning for the last.—GEORGE S. BRADY.

Ford at Fifty. New York: Simon & Schuster, Inc. 108 pp. $2.95.

HERE is a pictorial record of the first fifty years of the Ford Motor Company. The presentation of this thrilling story in illustration, typography, and format is on the same high plane as the success the company has attained during the first half century of its public service.

The foreword to the volume over the

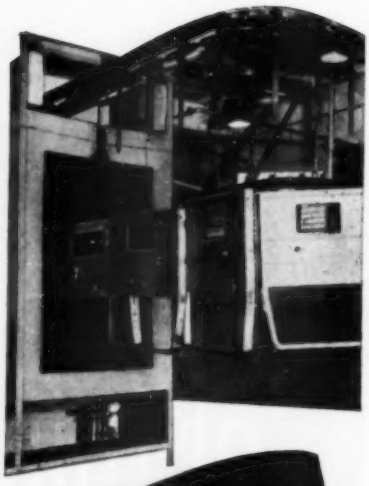

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Illustration shows cab doors for Autocar trucks being cleaned, phosphate coated, and dried.

This METALWASH phosphate coating machine provides an ideal surface for a lasting paint finish on truck chassis and sheet metal parts.

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Metalwash Finishing Engineer, published quarterly, is available on request to engineers and executives to whom cleaning and finishing are operations of interest.

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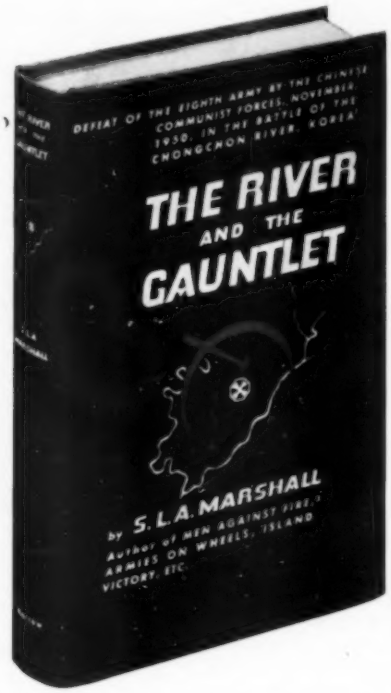
DEFEAT OF THE EIGHTH ARMY BY THE CHINESE COMMUNIST FORCES, NOVEMBER 1950, IN THE BATTLE OF THE CHONGCHON RIVER, KOREA
THE RIVER AND THE GAUNTLET
by S. L. A. MARSHALL
Author of MEN AGAINST FIRE, ARMIES ON WHEELS, ISLAND VICTORY, ETC.

AMERICAN ORDNANCE ASSOCIATION

Book of the Month for July

THE RIVER AND THE GAUNTLET

BY S. L. A. MARSHALL

S. L. A. Marshall, one of the great modern students of war, gives you his long-awaited report on the defeat of the Eighth Army by the Chinese Communist Forces in November 1950. This is the battle of the Chongchon River as Marshall saw it and as he reconstructed it from interviews with officers and men of the 2nd Infantry Division—the outfit that took the first and hardest blows. Here for you to read are the circumstances that led to defeat, the reconstruction of the confused, bitter fighting, the truth of *exactly* what happened in a major disaster to American arms. "The River and the Gauntlet" is both a clear presentation of the big picture and a magnificent recital of the many swirling small-unit actions that are part of a major retreat. Thirty-four maps and seven illustrations of weapons help you follow the action. Retail, $5.00.

To Members, $4.50

THE CONSERVATIVE MIND

By Russell Kirk

An avowed enemy of all forms of socialism, Kirk defends true conservatism in thought as both freedom and true liberalism. He takes sharp issue with the intellectual blunders which have surrendered our freedom of action to the Russians. Retail, $6.50. To Members, $5.85.

THE AMAZING MR. DOOLITTLE

By Quentin Reynolds

Speed flier, Tokyo raider, Air Force lieutenant general, researcher, industrialist—Jimmy Doolittle has been all of them. Quentin Reynolds tells the story of one of America's most brilliant men. Retail, $3.95. To Members, $3.55.

A WINDOW ON RED SQUARE

By Frank Rounds, Jr.

A vivid, well-documented story of Soviet life today. Retail, $3.00. To Members, $2.70.

History of the

GERMAN GENERAL STAFF

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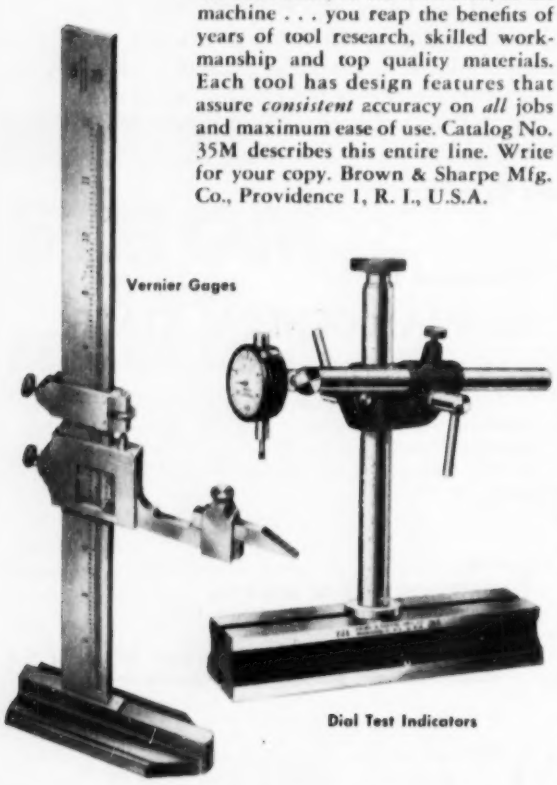

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Book Reviews

signature of Henry Ford II, president of the company, tells this story better than one might attempt otherwise:

"While this is a portrait of an American industrial enterprise taken in its fiftieth year, it is also a look at America and people at work. It is not the whole story of America but by describing this company—a piece of America and, in the eyes of many at home and abroad, a completely American institution—we have tried to say: 'Here is the way Americans work—here is the way they do things—here is a piece of their life.'"

Those operations in this highly illustrated volume which are devoted to the methods, production techniques, and products of the Ford Motor Company are so realistic as to equal a visit to The Rouge itself. So, too, are the portrayals of the men who are now responsible for the successful direction of this vast enterprise.

To the Ford Motor Company on its fiftieth birthday all friends will extend congratulations on a splendid portrayal of the first fifty years and good wishes for continuing success throughout the second.—L. A. Codd.

The Return of Germany. By Norbert Muhlen. Chicago: Henry Regnery Company. 310 pp. $4.50.

GERMANY today is a giant laboratory where the democratic system sponsored by the United States and the Soviet system sponsored by the U.S.S.R. are being tested. The conditions are almost equal in that the people concerned are from the same fatherland, speak the same language, and have not previously been subjected to either system.

East Germany is a separate country from West Germany today, and it is undetermined just how far either has changed from the Nazi or pre-Nazi philosophy of life. The German people are still more numerous than in any other Western European country. Germany also has the resources, the initiative, and the drive to lead Europe again if given the chance.

The questions relating to their future, their reliability as allies, their anti-Semitism, the effects of seven years of occupation are all discussed fully by the author who has traveled widely in Germany, has interviewed many people, and has presented the evidence here upon which to judge. He writes:

"Germany is still ready to take the road America opens to her; what is not possible is to build a free Germany to the West without bringing the West and ourselves to a free Germany."—Thomas K. Vincent.

Accounting Guide for Defense Contracts. By Paul M. Trueger. New York: Commerce Clearing House, Inc. 323 pp. $7.50.

EVERY ONE engaged in defense contracts should find this book of great interest and aid in understanding and appreciating the complicated accounting problems connected with these contracts.

Mr. Trueger, in drawing upon a rich background from his former association with the Contract Audit Branch, Army Air Force, has been able to present a complete "how-to-do-it" of solving the many steps and puzzlers one might encounter as a Government contractor. His personal "slants" and interpretations of controversial problems are of considerable interest.

Types of armed service contracts, recording purchases, manufacturing and engineering overhead, contract termination, renegotiation, and accounting procedures are all skillfully analyzed with the positions of Government and industry fairly stated on certain very technical and complicated issues.

To make this practical working text of greater value, the reader is introduced to the practices and procedures of the Armed Services Board of Contract Appeals and becomes acquainted with the income-tax aspects of defense accounting problems.—S. M. Smolensky.

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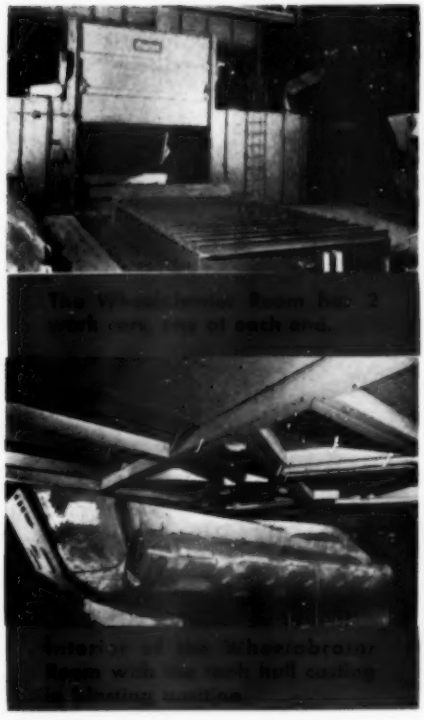

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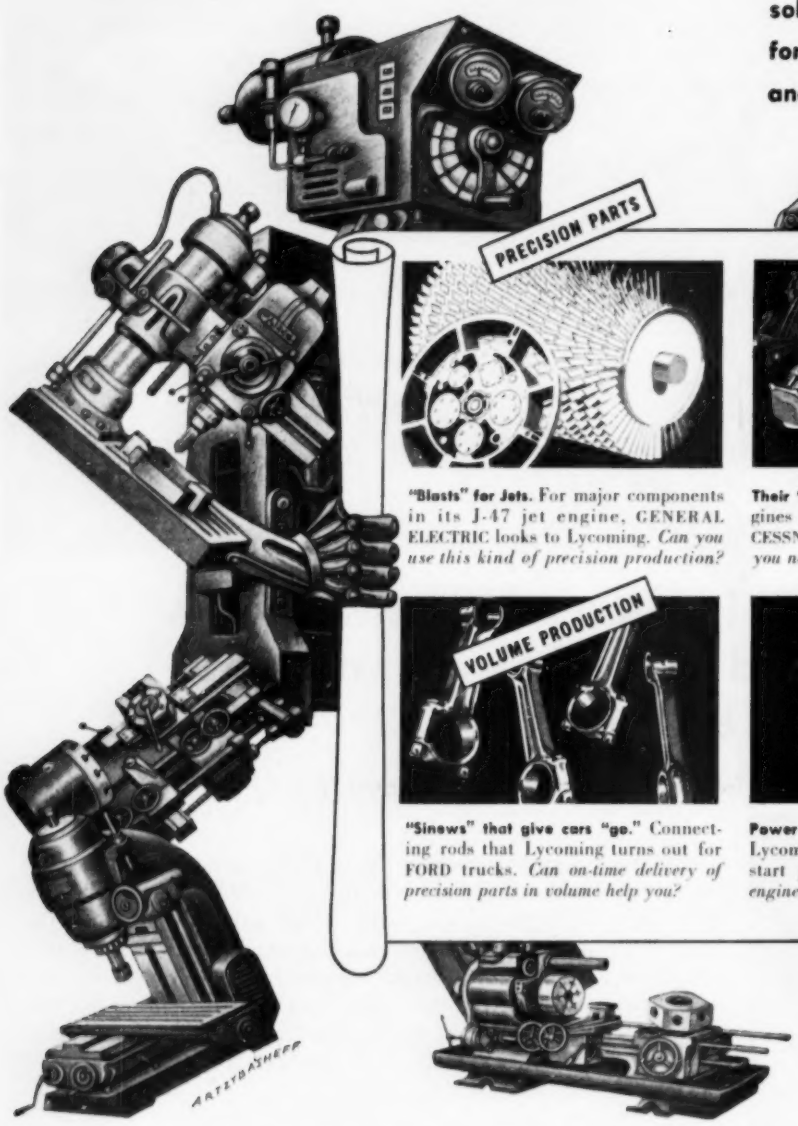

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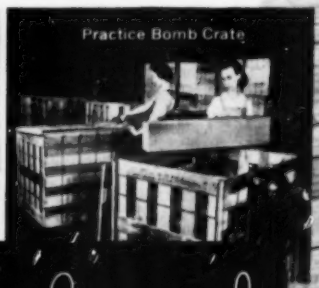

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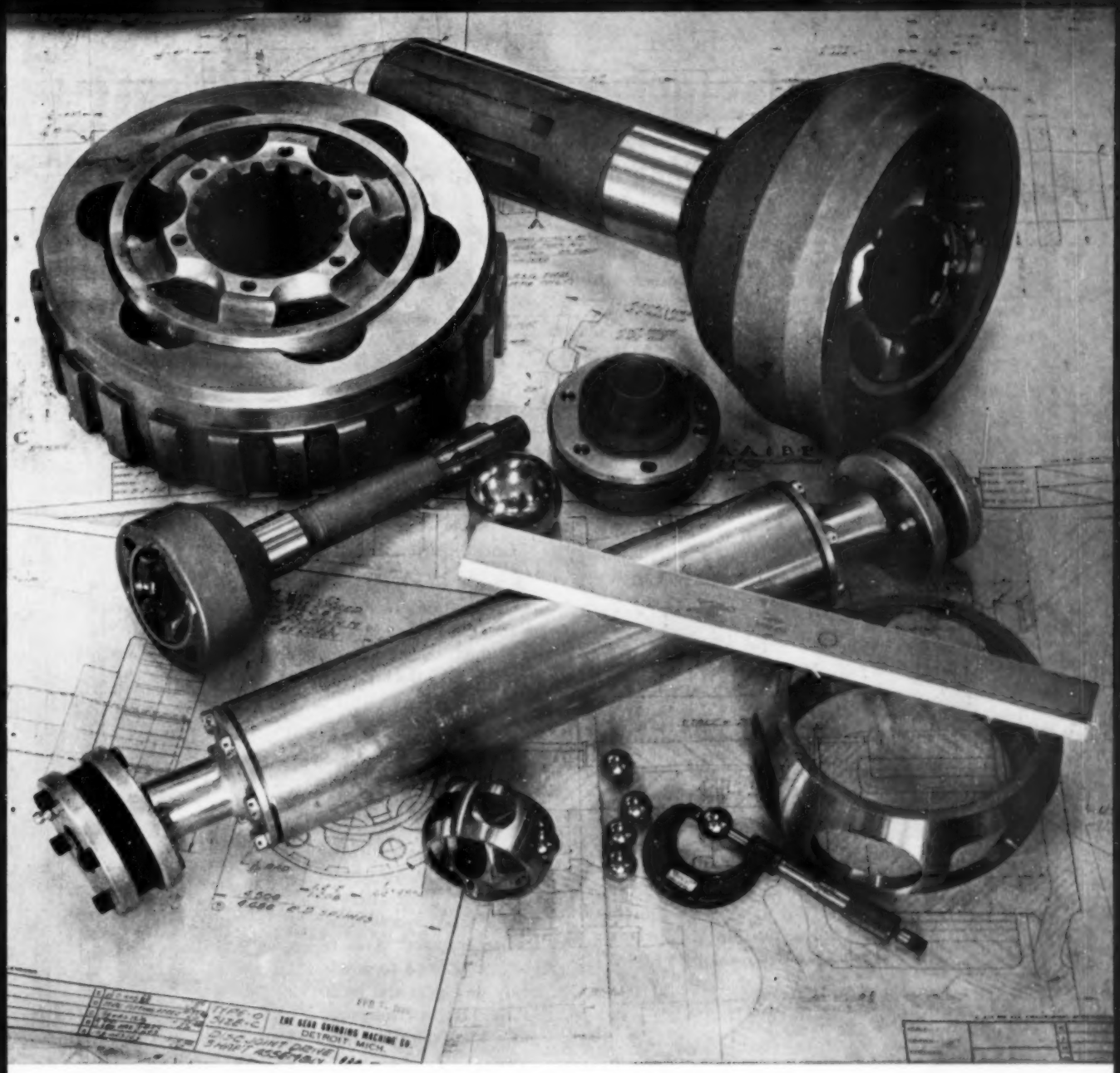

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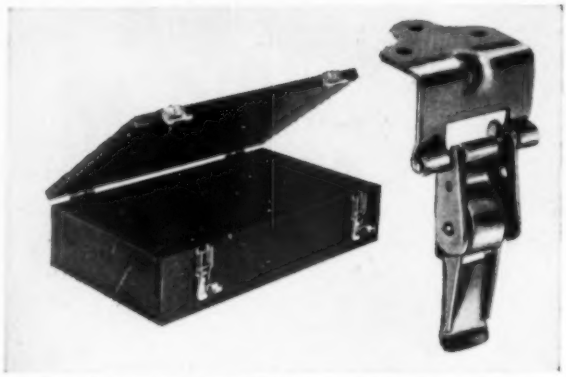

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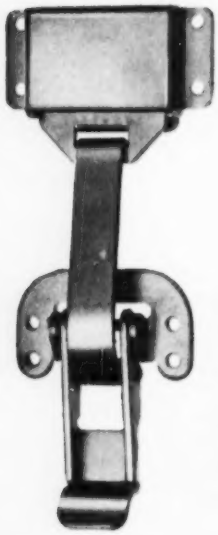

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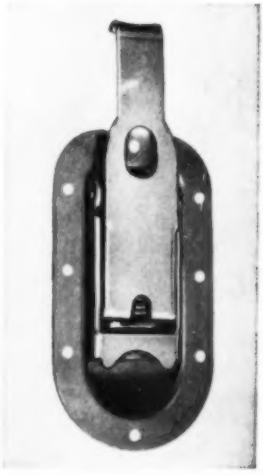

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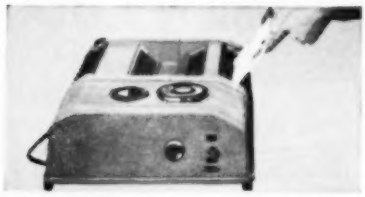
Remington Rand Methods News



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The systems flexibility you need in controlling complex, "tailor-made" production, can certainly be found in adaptations of the punched-card principle, visible record principle, or both, depending on the nature and scope of your factory operations. Remington Rand production control specialists will be glad to make specific suggestions without obligating you in any way, whenever you're ready. But in the meantime, why not read the detailed story on the Rotary Lift Company's complete, coordinated system? Mail the coupon for free copy of **CR 801.**

It's Here! A Completely Descriptive, Low-Priced Bookkeeping Machine

Now, for about one-third the price you'd have had to pay for a "big" descriptive bookkeeping machine, you can have the same, basic time and work-saving advantages. It's a simple machine, easy to operate with its touch-method keyboard, and you can use it for any kind of work – payroll, job costing, inventory, receivables, payables, general ledgers, and many special jobs. It gives you simultaneous posting of all records, complete typewriter description of entries, and complete figurework. You can get five or more totals for posting, distribution and control (up to 140 digits of totals). Ask for demonstration locally or mail coupon for free folder **AB-664.**

PROFIT-BUILDING ***IDEAS*** FOR BUSINESS

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P-344 X-1202

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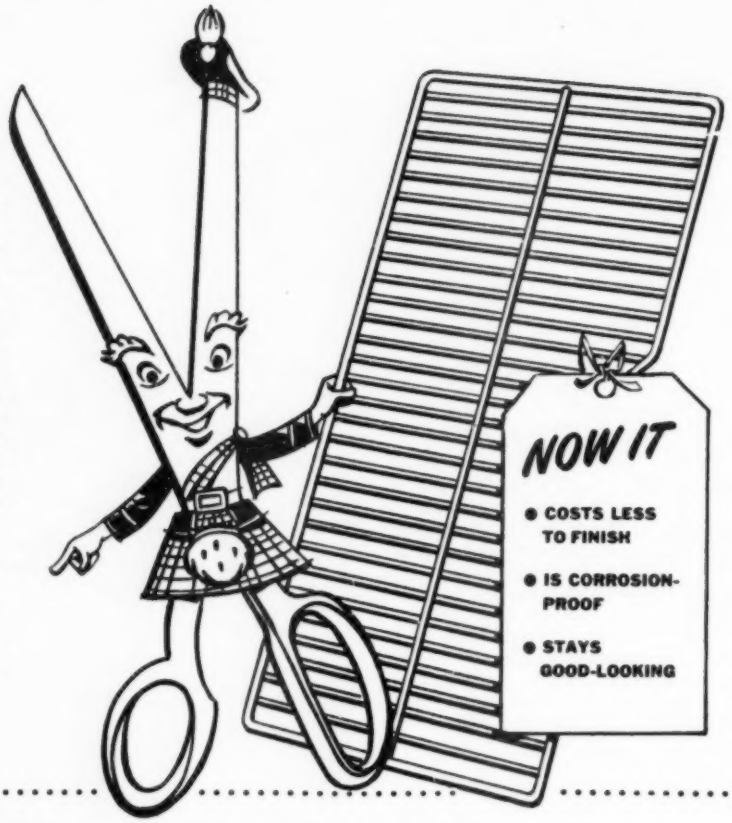
1-19

One simple finishing change saved $15,000

THIS mid-west refrigerator maker was having trouble with the clear enamel used to coat chromium plated refrigerator shelves to prevent rusting at the welds. The coating had poor resistance to wear. Sliding dishes and handling wore off the coating at spots – making the shelves unsightly.

Bringing into play United Chromium's long and diversified experience with both organic and plated finishes, "The Unichrome Man" recommended a Clear Enamel *developed especially for chromium* to seal it against corrosion.

Results: With just a single application, this Unichrome Enamel gave *double* former film thickness of a coating that could take abuse. Both corrosion and wear were licked. And despite the thicker coating a $15,000 yearly saving on material costs.



MORE WAYS TO SAVE IN THE COATING OF METALS

Plating time cut 50%.

By plating with the Unichrome SRHS Chromium Solution, an aircraft supplier finishes bushings in 2½ to 3 hours instead of 6. Plate is smoother, reducing polishing time, too.

Money-saving corrosion control.

"Still in excellent condition after 5 years" reads a report about Ucilon Protective Coatings applied to brine tank interiors at a North Central plant.

40% saved on material.

When chromate treating zinc die castings in Unichrome Dip, one automotive supplier found material costs 40% less than with former *"homemade"* solution . . . with job done as good or better.

TO FINISH IT BETTER AND SAVE

call in "The Unichrome Man"

UNICHROME

Trade Mark

It pays to consult United Chromium on Metal Finishing Problems

United Chromium offers you the advantages of: (1) 25 years of specialized experience in metal finishing; (2) Wide experience in *both* organic and plated finishes; (3) A diversified line of products for decorative and functional finishing – including plating processes, protective coatings, chemical conversion coatings for zinc; (4) Thinking geared to *cost-cutting, product-improving* possibilities.

We'd welcome an opportunity to help you "Finish it better AND SAVE."

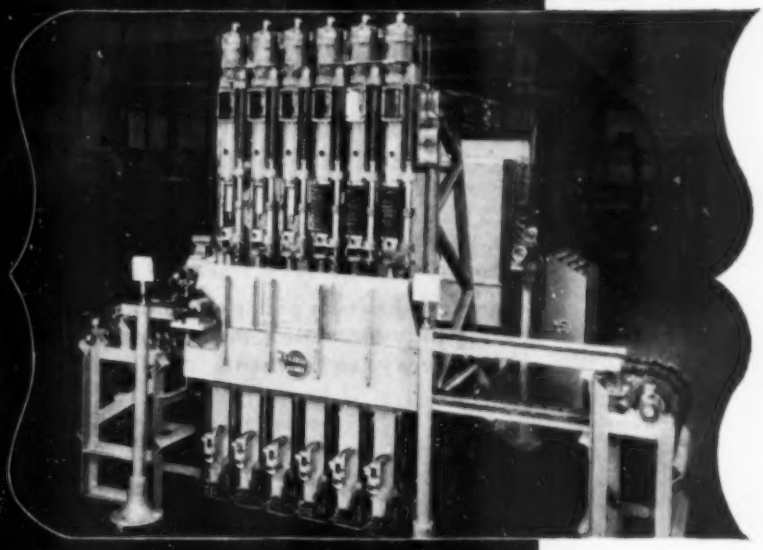
UNITED CHROMIUM, INCORPORATED 100 East 42nd St., New York 17, N. Y.

Waterbury 20, Conn. • Detroit 20, Mich. • Chicago 4, Ill. • Los Angeles 13, Calif. In Canada: United Chromium Limited, Toronto, Ont.

Cavity Facing and Shell Banding Equipment By W.F. & JOHN BARNES

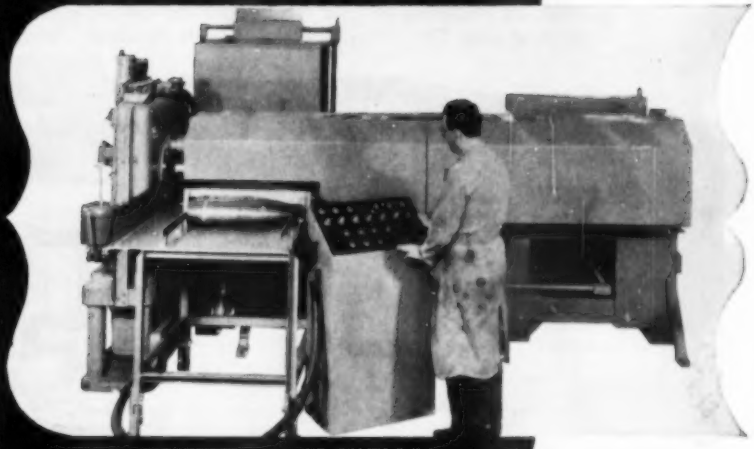
Over 1000 105 MM Explosive Shell Charges Faced Per Hour

Now face or drill cast or consolidated explosive shell charges fast, accurately and with full remote control safety. This Barnes Machine can be furnished to accommodate shells from 57 MM to 8" including 2.36, 3.5, 4.5 rockets and 81 MM and 4.2 mortars. Fully interlocked mechanisms eliminate operators from the hazardous area. Illustrated is a 6-spindle model; 2 and 4 spindle machines are also available.



Band Over 300 105 MM Shells Per Hour

The machine illustrated will receive the shell and the band, transfer them to the multiple jaw banding head, band in a single squeeze motion and eject the banded shell in a completely automatic cycle. A minimum of work hardening of the rotating band is a direct result of this single squeeze banding method. This machine will band either live or inert ammunition. Auxiliary equipment for the banding operations includes machines for band resizing, band deburring, band size checking and debanding. Infeed and take away conveyors, custom designed to suit your plant, can be furnished as a package with the Banding Machine.



Other BARNES Ordnance Equipment

In addition to these machines, the Barnes Company has designed and manufactured machines in the following categories:

a) Zone storage units,
b) Zone weigh handling mechanisms,
c) Fuze tensioning machines,
d) Custom handling devices for all phases of Ordnance work.

Complete electrical, hydraulic and mechanical facilities are available to coordinate these mechanisms into a smooth processing operation.

Free Additional Literature

is available on all Barnes Ordnance equipment. Since it is impossible to give the complete scope of operation in this restricted space, we invite you to write for the complete Barnes Ordnance book. Ask for bulletins O-753.

W. F. and JOHN BARNES

PROCESS EQUIPMENT DIVISION 388 SOUTH WATER STREET, ROCKFORD, ILLINOIS

Gas engines or Diesel . . . South quick starting from one heater...

Model 978 MF
20,000 BTU/hr.
fresh air output

engine pre-heating plus personnel heating plus defrosting. Models for every requirement.

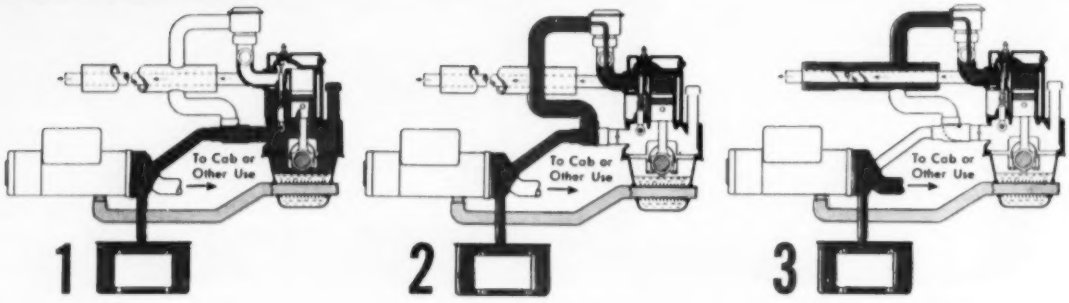
Here's powerful, *sure* pre-heating for brutally tough-to-start diesels as well as gas engines of every type. Compact, adaptable, dependable South Wind Pre-Heating Systems assure the quick starting required by Military Services even at 65° below! One heater provides engine pre-heating – cab heating – defrosting!

South Wind Pre-Heating Systems reduce battery drain by reducing starting torque, cut the cost of starting aids. They eliminate shock loads imposed by brute-force starting methods, prolong engine life and lower maintenance cost.

Only clean, *dry* air is fed to engines by South Wind Pre-Heating Systems. They permit use of optimum viscosity lubricants and assure normal lubrication at all times. Inhibit sludge formation and freeze-up of engine accessories, too.

South Wind's equipment for internal and external pre-heating includes units of 20,000, 30,000, 50,000, 60,000, 90,000, 100,000, 200,000, 600,000 and 700,000 BTU/hr. capacity. South Wind's experienced field engineers will be happy to consult with you on any pre-heating problem, whatever its scope or complexity. Write today to: South Wind Division, Stewart-Warner Corporation, Indianapolis, Indiana.

South Wind 3-Phase INTERNAL PRE-HEATING



Pre-Heat Phase

Clean, *dry* hot air is used to pre-heat critical engine moving parts directly and to remove damaging moisture from the engine interior – *before engine cranking is attempted.* (Note: Heat duct to the cab for heating and defrosting remains closed until after the engine is started.)

Starting Phase

Heat into engine crankcase is diverted (as shown) to air induction system to elevate temperature of fuel-air mixture and promote rapid, normal combustion in chambers. Internal pre-heating of critical parts and normal lubrication frees bearings, shafts, pins and pistons from starting strain and friction wear.

Operational Phase

After easy starting, normal engine operating conditions are sustained. Now, South Wind's clean heat can be used to heat the cab, defrost windshields and supply engine induction air heat. (Note: Illustration shows how normal engine induction air temperature can be sustained by engine exhaust heat exchanger.)

Wind pre-heating systems assure even at 65° below!

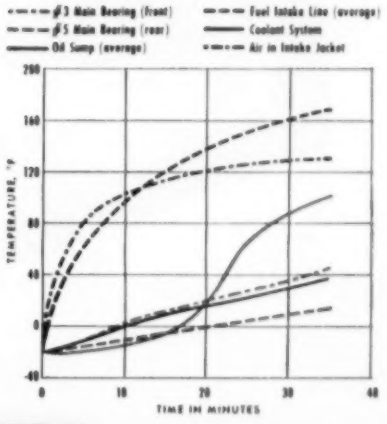
Studies Prove South Wind Superiority

South Wind's entirely new principle of scientific pre-heating has been developed, tested and proved *in the field*, as well as in Stewart-Warner's Laboratory Cold Room.

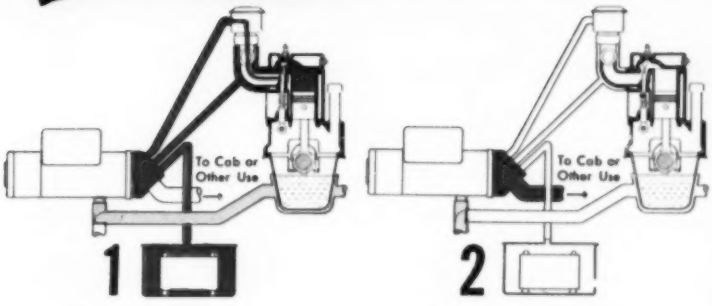
Here is typical temperature record of critical engine components during pre-heating (only minimum capacity 70,000 BTU/hr. pre-heater kit used). This heat provided adequate temperature rise for easy starting—with less than 5-seconds cranking.

Data is based on a 6-cylinder, 2-cycle 225 HP Diesel engine weighing 3,000 pounds.

Temperature vs. Time of Diesel Engine Components



South Wind 2-Phase EXTERNAL PRE-HEATING

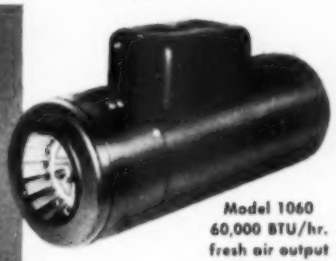


Pre-Heat Phase

Clean, *dry* hot air is applied to the exterior surface of the carburetor and intake manifold, and to the battery, by the use of shrouds. The oil sump is heated in like fashion by hot gases from the heater exhaust. (Clean, hot air which enters the air intake is, in some cases, provided for the starting phase.)

Operational Phase

After starting engine, clean, hot air from the heater is diverted to cab for personnel heating, defrosting and other use. (If the application demands, part of this air can be used to provide continuous heat for battery and/or air induction system.) Heater exhaust is diverted directly to atmosphere.



Model 1060
60,000 BTU/hr.
fresh air output

Model 1030
30,000 BTU/hr.
fresh air output

South Wind

A PRODUCT OF SW STEWART-WARNER

PERSONNEL HEATING
ENGINE AND
EQUIPMENT PRE-HEATING
WINDSHIELD DEFROSTING

Another Example of Beaird Manufacturing Skill

CAST STEEL FITTINGS

The Beaird machining division has, for twenty-seven years, produced a full line of cast steel flanged fittings, screwed fittings, return bends and large flanges. They can be found throughout the nation and in many foreign countries installed in petroleum and chemical plants, pipelines, ships and barges.

THIRTY-FIVE YEARS' EXPERIENCE in manufacturing a wide variety of products have made Beaird unusually well equipped to handle large production orders of ordnance materials.

Central location near Southwest ports
Ample supply of Skilled labor
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Experienced engineering staff
Trained inspection department
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PACKAGED COMPRESSOR PLANTS | L P GAS SYSTEMS | CAST STEEL FITTINGS | ANHYDROUS AMMONIA EQUIPMENT | PRESSURE BULK STORAGE

LET CONTINENTAL PROVIDE PACKAGES

for your defense products

Continental offers—

More than 500 sizes and styles of standard cans in regular production.

Facilities for designing new packages for unusual needs.

Choice of lining materials . . . non-rusting, non-reflecting military coatings.

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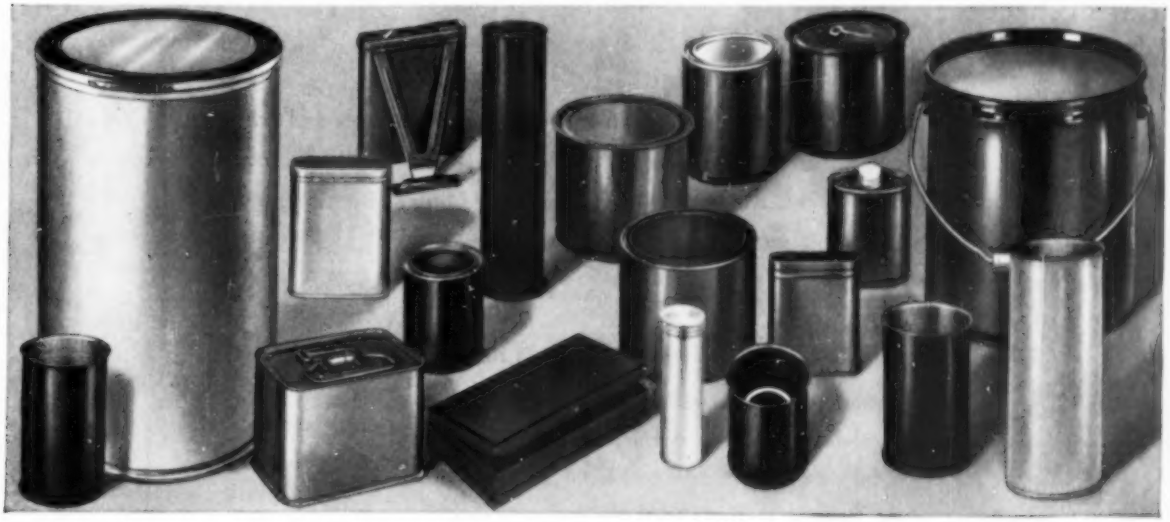

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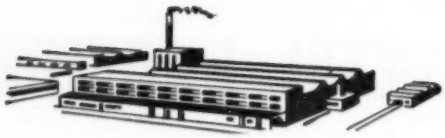

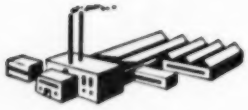

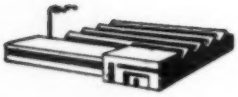

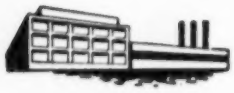

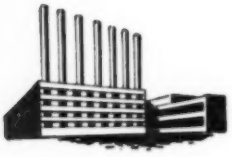

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Pressed Steel Car Company offers a broad range of products and services available to industry throughout the world. Always alert to new processes and technological advances Pressed Steel Car Company throughout the years has maintained a reputation for more efficient, higher quality products.

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- *Locomotives and trackwork to cookware*
- *Agricultural and farm machines to milk cans*
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TARGET SELECTION

Hitting the selected target has been a prime problem since man first armed himself. However, unlike the problem which faced the primitive native with his bow and arrow, selecting targets for guided missiles involves many new techniques.

Fairchild's Guided Missiles Division was among the first in this country to undertake the design and development of complete missile guidance systems. The systems have been proven in test missiles flown by all three branches of the Armed Services and are among the most advanced types.

Research in the Fairchild Guided Missiles laboratories includes all the basic guidance systems such as surface-to-air, air-to-air and air-to-surface missiles. The division has developed an engineering and production team experienced not only with guidance systems but also with the aerodynamic, structural and propulsion problems associated with missiles.

ENGINE AND AIRPLANE CORPORATION

FAIRCHILD

Guided Missiles Division

WYANDANCH, L. I., N. Y.

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MISSION ACCOMPLISHED

. . . By the Versatile M-8E2 Cargo Carrier

Build a gun emplacement and move a big gun into position . . . excavate a second pit for the gun's generator and bring up necessary equipment and personnel — fast! This could be one of many routine assignments for the M-8E2 — the all-purpose, 22-ton cargo carrier built by Allis-Chalmers and designed in cooperation with the Army Ordnance Corps.

Takes off across country.

The M-8E2 heads for the site of the future gun emplacement at speeds up to 40 mph. Power and mobility enable this giant prime mover to handle rough, off-road assignments — through mud, up and down slopes as steep as 60 percent.

Starts excavation.

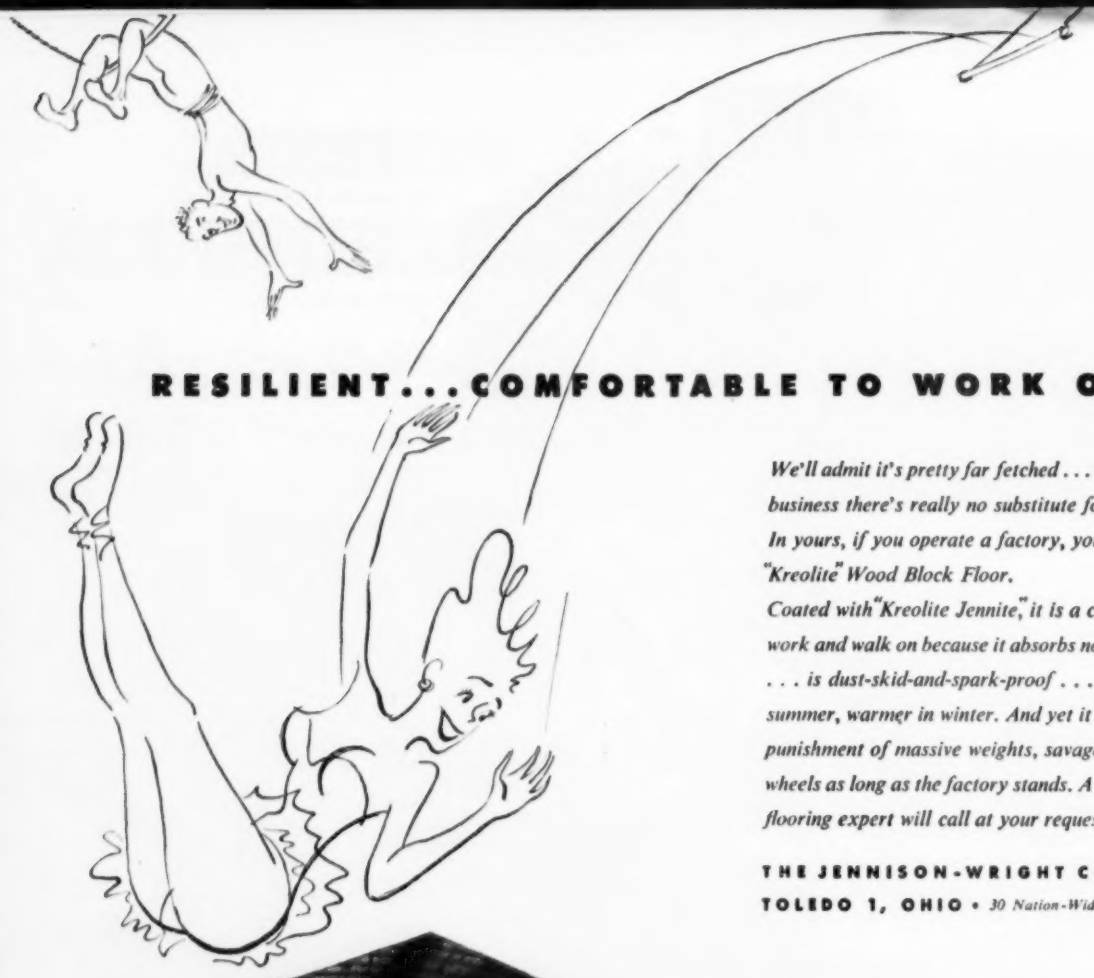
With bulldozer attachment, the M-8E2 quickly cuts down and levels floor of the emplacement . . . mounds up dirt to a height of 10 feet.

Big gun moves up.
Antiaircraft gun is easily hitched to drawbar of the M-8E2 and hauled into position. Notice generator mounted on back of the cargo carrier.

Lowers generator into place.
Special mount enables the M-8E2 to lower generator into pit hydraulically. Equipped with especially designed booms and winches, this machine becomes a powerful wrecker. For easy servicing in the field, all major components of the M-8E2 are interchangeable with those of other members of the light tank family.

Carries gun crew.
This versatile machine carries gun crew as well as ammunition and other equipment. Assistant driver stands on seat to operate machine gun.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.



RESILIENT...COMFORTABLE TO WORK OVER

We'll admit it's pretty far fetched . . . in the Circus business there's really no substitute for a safety net. In yours, if you operate a factory, you can't beat a "Kreolite" Wood Block Floor.

Coated with "Kreolite Jennite," it is a comfortable floor to work and walk on because it absorbs noise and vibration . . . is dust-skid-and-spark-proof . . . is cooler in summer, warmer in winter. And yet it will take the punishment of massive weights, savage blows, grinding wheels as long as the factory stands. A Jennison-Wright flooring expert will call at your request.

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TOLEDO 1, OHIO • *30 Nation-Wide Offices*

SPECIFY "KREOLITE"...

Over 250 million square feet used by leading industries since 1911

1 Comfortable to Work Over
2 Durable-Stand Up Under Abuse
3 Protect Dropped Tools and Parts
4 Quick to Install—Easy to Replace
5 A Firm Foundation for Machines
6 Absorb Noise-Cut Down Vibration
7 Insulate Against Heat and Cold
8 Spark-Proof, Skid-Proof, Safe*
9 Provide for Conduits and Cables
10 Dustless-Easy to Clean
11 Good for Trucking Aisles
12 Lowest Maintenance Cost

**A "Kreolite" Wood Block Floor is cleaner and safer (because skidproof) when given a final coating of "Kreolite Jennite," our new exclusive final filler and finish that does not become tacky.*

KREOLITE WOOD BLOCK FLOORS

ALSO KREOLITE RAILROAD SWITCH & INDUSTRIAL TRACK TIES · PILING · BRIDGE & DOCK LUMBER

the extra BRAKING STAMINA proven here...

Dam Construction on the Columbia River.

Rugged Bendix-Westinghouse Air Brakes Keep Giant Earthmovers on the Job Day After Day!

Why not take a braking tip from the men who operate the rugged off-the-road giants? They'll tell you it takes **stopping power, durability and performance-plus** to provide perfect braking control for nearly 50 tons of solid rock and steel, defying gravity up grade and down under the very toughest of operating conditions. Ask them what brakes they choose for this tremendous task and time after time you'll get the same answer—Bendix-Westinghouse. That's because these mighty brakes, built by the industry's most experienced manufacturer, pay off with the **safest, surest, most dependable braking action** and longest service life in the business. And these are factors that make these mighty brakes your logical choice for any ordnance vehicle. That's why, when you specify brakes, you can **be sure of the utmost in safety, dependability and stamina** by specifying Bendix-Westinghouse — the world's most tried and trusted air brakes! Performance proven for peak reliability on ordnance vehicles in World War II.

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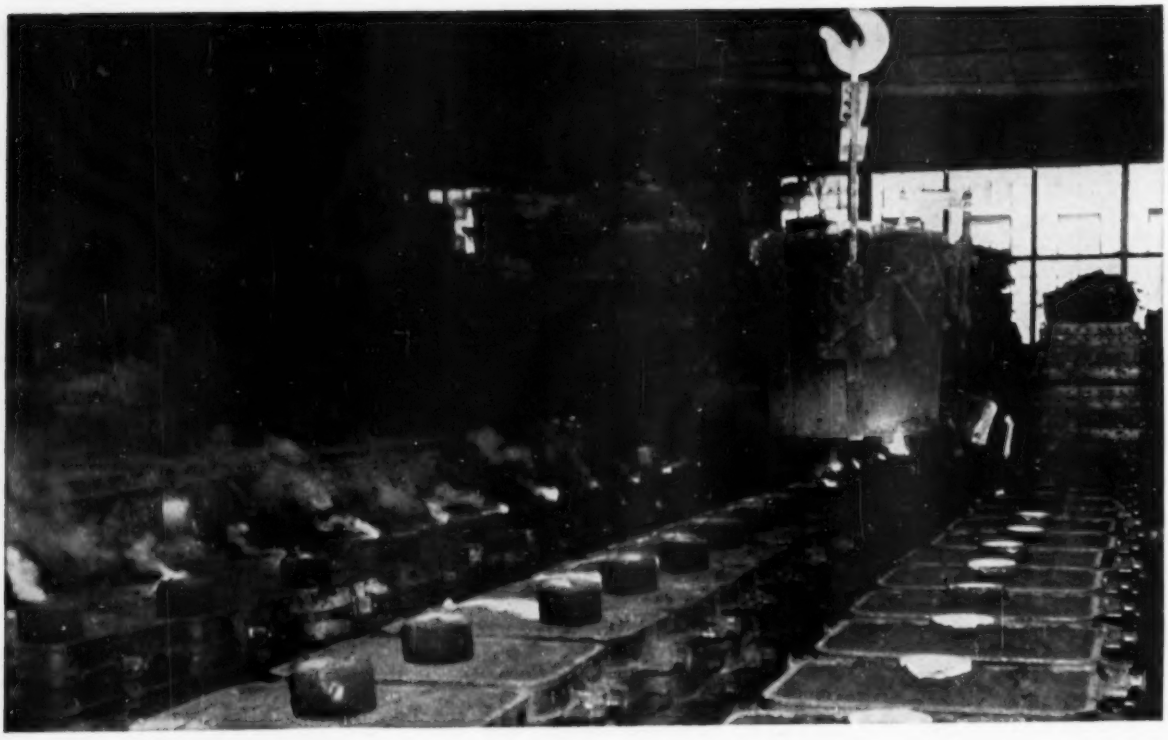

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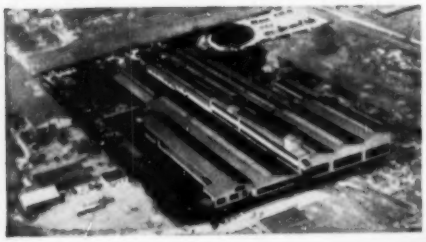
STEEL OR GRAY CASTING PROBLEMS

Riverside Foundry is ready to give you excellent service on cast armor and all types of QQS 681-B materials. **In fact, any steel casting specifications for which your contract might call.** We have a full staff of men who have spent years producing ordnance material.

Our customers include many great names of American Industry: Chrysler, American Locomotive, International Harvester, Fisher Body and Ford Motor Company. **Ask them about Riverside.**

Call or write us at Riverside today.



The big modern Riverside Foundry at Bettendorf, Iowa has the best equipment to do the best job.

For a dependable qualified source of steel casting requirements, see Riverside. You give us your drawings. The rest of the job is ours. Save yourself time, worry and loss of production. We are ready to do a complete job for you on any casting requirement.

Ketay gives you a complete variety of sizes and types of Synchros and Servo Motors

WHATEVER THE NEED CHOOSE KETAY!
Available as listed

1. SYNCHRO, Size 16, O.D. 1.537", 115 V, 400 Cycles *(Transmitter, Receiver, Control Transformer)*
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5. SYNCHRO, O.D. 1.437", 14.4 V and 26 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
6. SERVO MOTOR Mk 7, O.D. 1.437", 115 V, 400 Cycles
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8. SYNCHRO, Size 31, O.D. 3.10", 115 V 400 and 60 Cycles *(Transmitter, Receiver, Differential, Control Transformer)*
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10. SYNCHRO, O.D. .937", 26 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
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12. SYNCHRO, Size 11, O.D. 1.062", 26 V and 115 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
13. SERVO MOTOR, O.D. 1.062", 115 V, 400 Cycles
14. SYNCHRO, Size 15, O.D. 1.437", 26 V and 115 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
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KETAY offers high precision rotary and instrument components for most every need in the Armed Forces and Industry. As the world's largest producer of government approved synchros, Ketay stands ready to solve your problems with a complete line of synchros, servos, magnetic amplifiers, computers and control systems.

If you are searching for a specific size or type... if availability is a problem... if engineering counsel is needed... Ketay can help. Why not join us for an exploratory discussion of your particular problem. Write today to Dept. J

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- KINETIX INSTRUMENT DIVISION
- RESEARCH & DEVELOPMENT DIVISION

MANUFACTURE ...of precision instruments, components, and systems.

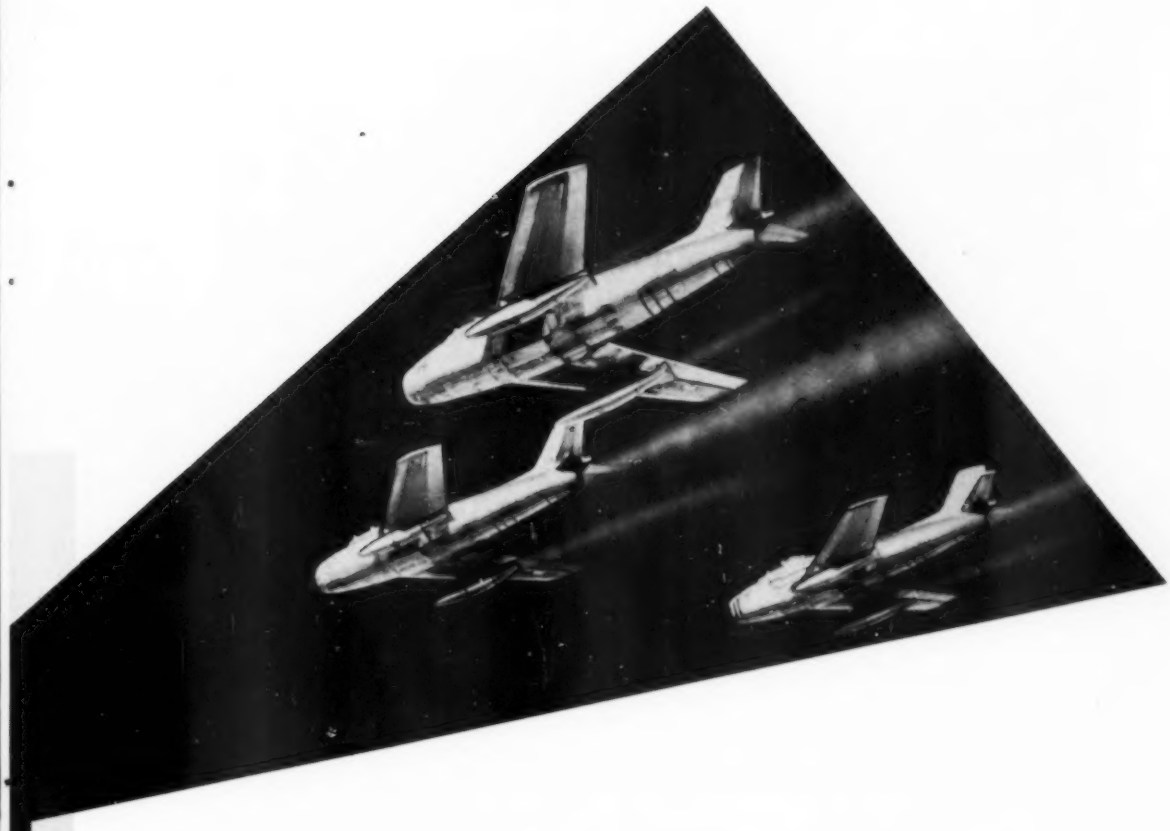
lest we forget...

Time and Distance —
They were weapons that gave us the chance to win — yesterday —
To preserve the freedom we enjoy today.

What will save our freedom in the years to come? —
For our future and the future of our children —
Now that Time and Distance are no more —
Devoured by the swift wings of supersonic planes?

Look out the window. What do you see?
A peaceful city — the ferryboats plying their way across the river;
Or the smokestacks of your factory, busy with the tasks of peace?
Is that all?

You've missed something — factories halfway round the world,
working night and day, preparing the latest implements of war.
For what? To blast your factory — turn your peaceful city into
a shambles — wipe out your freedom.



What's the driving force behind all this hostile activity?
The foresight and imagination of zealous men who hate what you love
and love what you hate.

Are they smarter than we?
Do they know what they want more clearly than we?
Can they plan for the future more intelligently than we? —
Their future — to supplant ours?

Do you know any magic that can take the place of foresight?
Any fancy words that can do the work of hard, conscientious planning now? —
Any miracles to rely on as substitutes for intelligent preparedness?

The American Ordnance Association doesn't either.
That is why it works to develop the finest team of scientists
and industrialists, to cooperate with our military experts,
to perfect the best armament in the world —
and factories ready to augment its production — at a moment's notice.

All men of vision and understanding, with the will to win, are
welcome in this effort — essential to your economic and physical survival.

American Ordnance Association

Mills Building, Pennsylvania Avenue at 17th Street, N.W., Washington 6, D. C.

In figuring costs, maintaining quality
and meeting production schedules

There's no substitute for
Specialized Experience

For over a decade
our organization and facilities
have been devoted exclusively to
the design and production
of military pyrotechnics

AERIAL PRODUCTS, INC.

ELKTON, MARYLAND

FLARE AND SIGNAL MUNITIONS - PHOTOFLASH MUNITIONS
DETONATOR AND BURSTER COMPONENTS FOR AMMUNITION
SHELL AND FUZE LOADING
DISTRESS SIGNALS - HAND-HELD ROCKETS

Order for two...

Orders for industrial *and* defense needs . . . both have to be filled in today's semi-military economy.

To help build our military might, for example, American Locomotive plants are busy turning out the Army's new medium tank . . . nickel-plated pipe for the Atomic Energy Commission . . . jet engine containers for the Air Force . . . and other defense products for all the armed forces.

And to help the nation's essential industries meet the challenge of an expanding economy, Alco is producing basic industrial products: diesel-electric locomotives for the railroads . . . process equipment for chemical and petroleum producers . . . springs, diesel engines and a host of others for many industries.

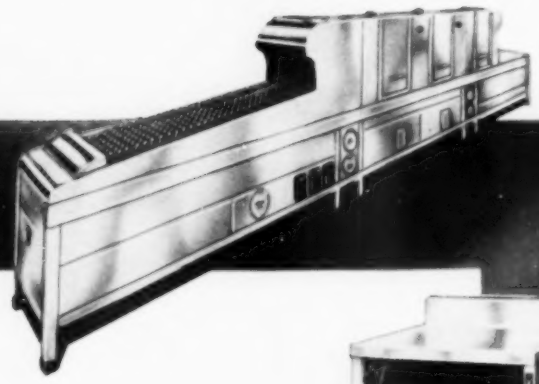
Output of *both* industrial and military products is essential to the nation's defense program. Industry produces *both* to keep America strong.

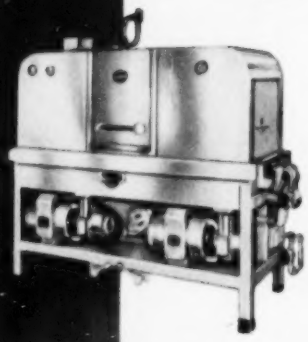
AMERICAN LOCOMOTIVE COMPANY

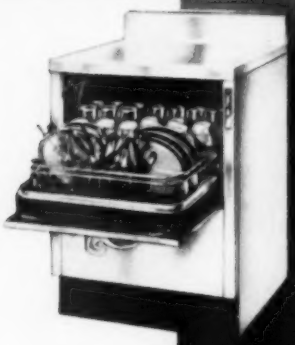
producing both industrial and defense products

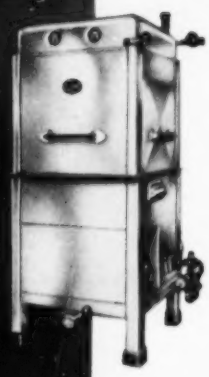
The Most Complete Line of Dishwashers

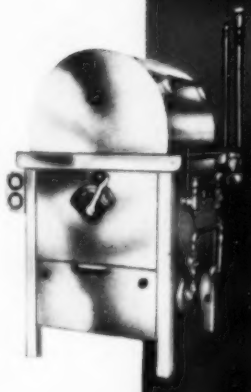
Here are 5 of the full line shown in this free booklet











For the *right* costs and the *right* standards—put the *right* machine on the *right* job. Do you know that Hobart builds *25* models of dishwashers and glasswashers—fully and semi-automatic—with and without Hobart Time Controls—little (2 ft. square) and big (29 ft. long, Flight-type continuous racking)? They're all described and pictured in this booklet.

Here's your chance to improve service and control costs—with Hobart installations *just right* for you. Just use the handy coupon to get your free booklet with pictures and details of the great line of Hobart machines. Send it now! . . . ***The Hobart Manufacturing Company, Troy, Ohio.***

Hobart
Trademark of Quality for over 50 years

Hobart *Food Machines*

The World's Largest Manufacturer of Food and Kitchen Machines

THE HOBART MANUFACTURING COMPANY, Troy, Ohio
Attention: **DEALER DIVISION**

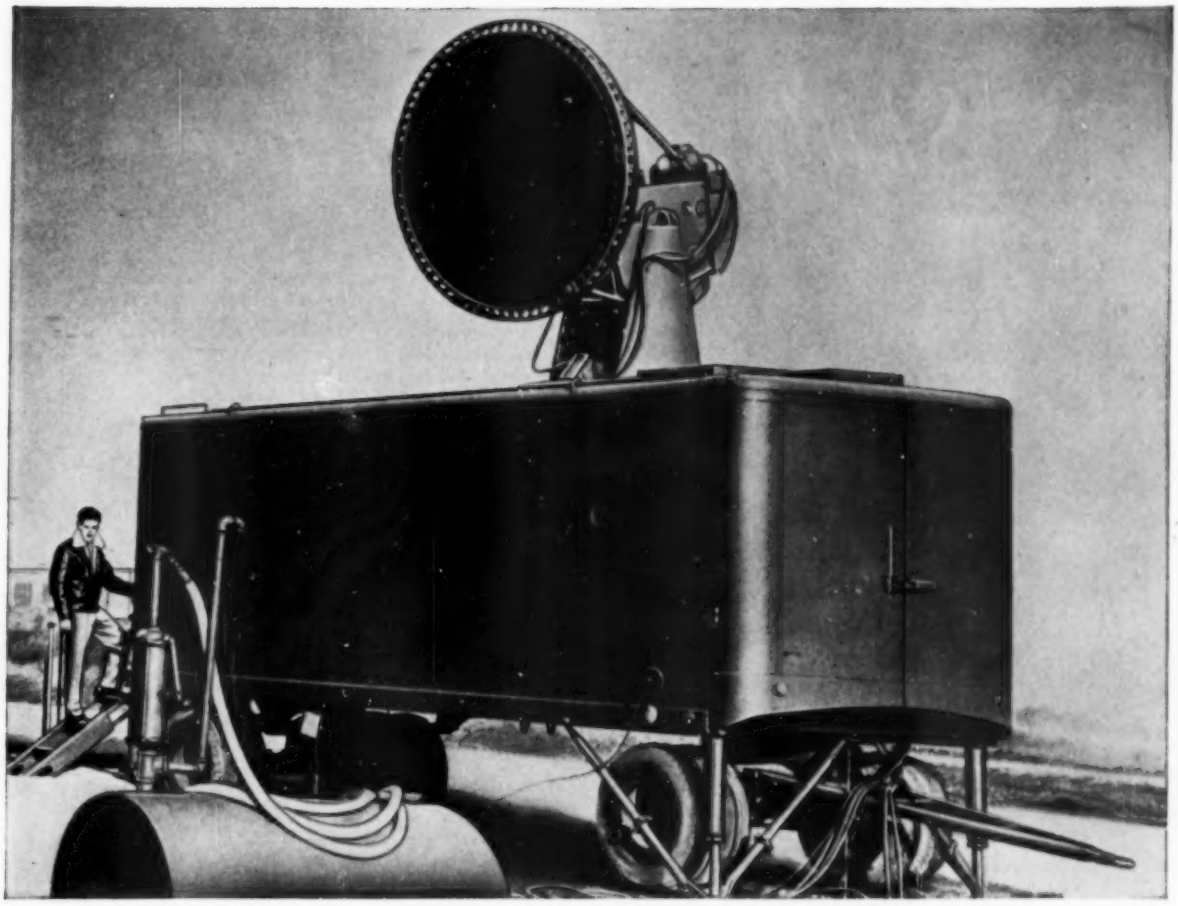
☐ Please send me without obligation your new Dishwashing Machines Folder.
☐ Please have representative call with full information.

NAME _____

BUSINESS _____

STREET _____

CITY _____ ZONE _____ STATE _____



It takes PRECISION MANUFACTURING to say "HERE THEY COME"

The big, round screen on top of the mobile trailer, is a radar antenna—part of a new fire-control system for anti-aircraft gun batteries.

Details are classified for security reasons. However, many improvements and refinements, make the device more informative, effective and flexible than its predecessors.

We make the radar antenna and the intricate, precision gears that actuate the system, for the Western Electric Company. Gears that must be precise, because gear errors of ten-thousandths of an inch, mean miles in the sky.

Ours is a record of 37 years of precision design, engineering development and production. Today, 90% of our defense work is in aircraft and ordnance contracts. We help work the miracles of exactness which strengthen the defenses and protect the security of America.

THE STEEL PRODUCTS ENGINEERING CO.

engineers and manufacturers
Springfield, Ohio

Skill...an acquired art

The ability to make a precision tool or die is a skill that comes only after long and thorough apprenticeship —an art slowly and carefully attained.

Eastern Tool & Mfg. Co.'s 29 journeyman tool makers represent more than 500 years of tool making experience, including the fabrication of many dies necessary to the manufacture of extremely close tolerance ordnance components.

These skills are being nurtured and expanded through our continuing apprenticeship program.

Write for descriptive bulletin No. 100

Eastern Tool & Mfg. Co.

Belleville 9, New Jersey

Wire Forming **Metal Stamping** **Deep-Drawing**

Skilled hands for faster firepower

Modern machinery and high-speed production literally have made this nation the richest and best in the world. And they will continue to be vital factors in maintaining that position. However, underwriting the performance of American industry and ability are the minds and the skilled hands of America's industrial workers.

The production of fine ordnance pieces for the government is a prime example. Hundreds of machines at the Evansville Works of the International Harvester Company turn out thousands of parts for the M1 .30 caliber Army rifle each day. But these machines must be operated by skilled craftsmen who have spent years learning the intricacies of fine machine work.

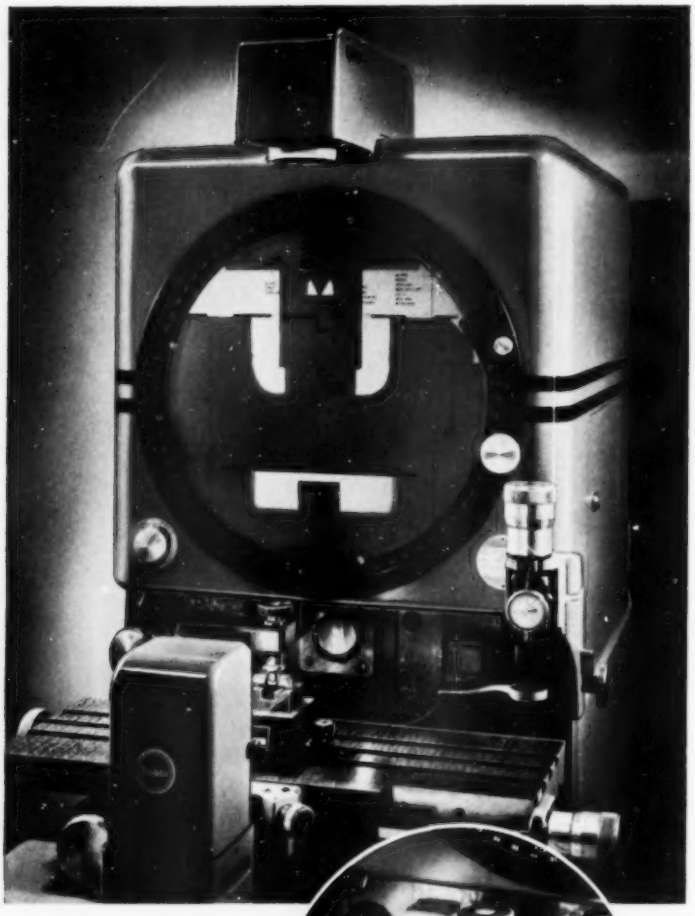
Many of the operations in the manufacture of the M1 rifle must be performed by hand. No machine ever has been developed that can take the place of the experienced touch and sight of highly skilled inspectors and assemblers, such as these men who are carefuly examining each part before they assemble it.

Upon the work of such men as these rests the accuracy and safety of the M1 rifle and the fast, accurate firepower it puts in the hands of the American soldier.

INTERNATIONAL HARVESTER Chicago 1, Illinois

Builders of products that pay for themselves in use . . .
International Trucks • McCormick Farm Equipment and Farmall Tractors
Crawler Tractors and Power Units • Refrigerators and Freezers

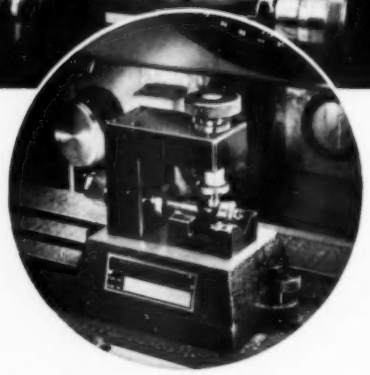
How to check dimensions *you can't see*



This gun part has 13 critical dimensions that are quickly and accurately checked by Optical Projection Gaging, even though four of the dimensions cannot actually be projected.

One of these "hidden dimensions," the distance from the inside diameter of the inner sleeve of the part to the bottom of the U-cut, is shown above being checked by means of a double target plunger. What appears on the screen is the plunger which is compared with the Chart-Gage laid on the screen. (At the same time the diameter of the part is also checked.)

This application of Optical Projection Gaging is typical of the fixtures and Chart-Gages we develop to inspect the most complex parts. And, usually you'll find Optical Gaging can do the job faster and at lower cost than other gaging methods. To see for yourself, send sample parts and specifications, or write and we'll have our local representative call on you.



Illustrated above is the part-shifting fixture for the gun part, with two definite positions of the part, two free dimensions of the part, and three definite positions of the plunger. This fixture permits checking overall length, depth of the assembly of the inner sleeve and end of part, chamfer, bevel on end of sleeve, depth and length of U-cut, distance of internal milled section from the edge of U-cut, distance of outside diameter from internal milled section.

OPTICAL GAGING PRODUCTS INC.

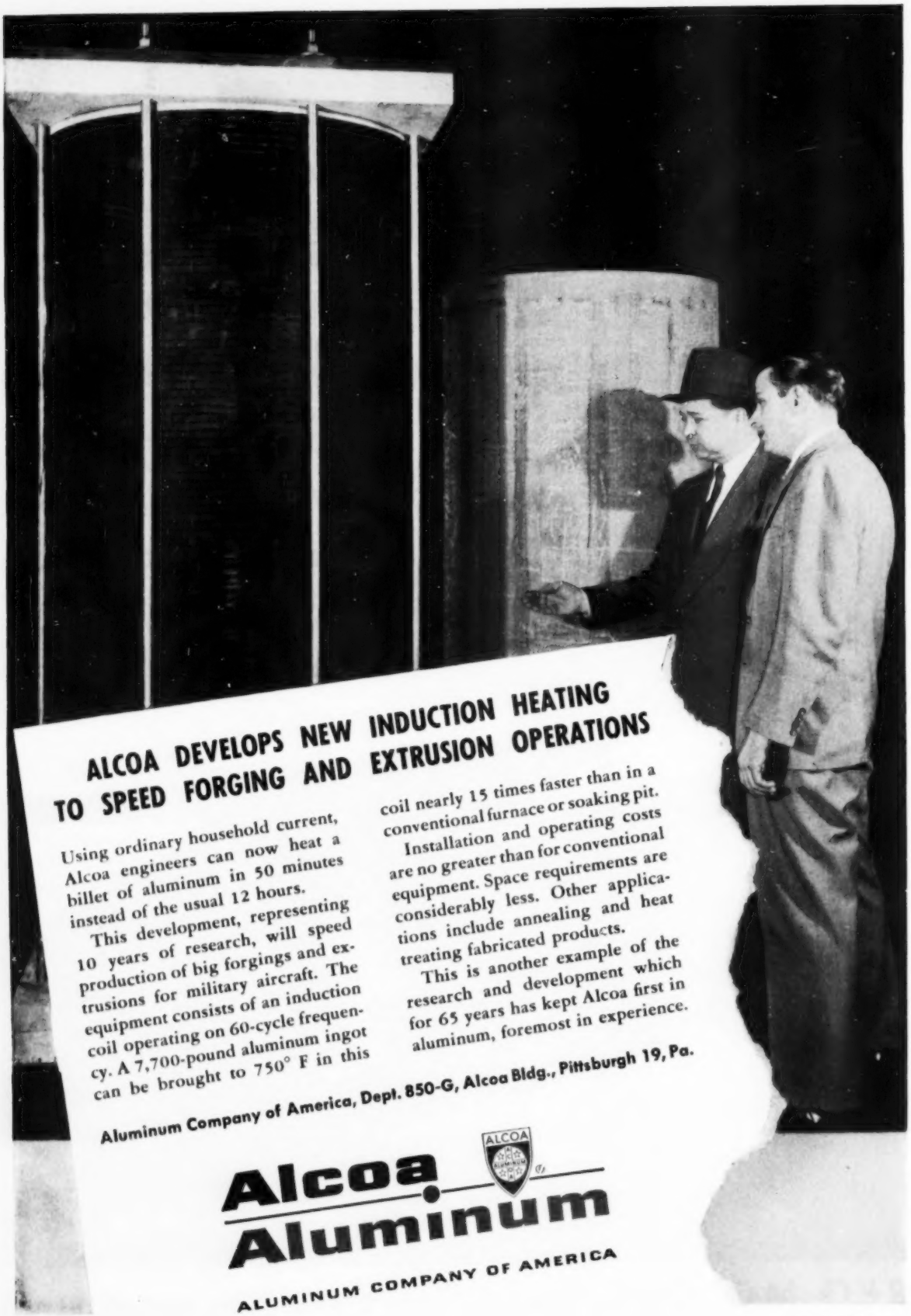
SUCCESSORS TO ENGINEERS SPECIALTIES DIVISION OF UNIVERSAL ENGRAVING AND COLORPLATE CO., INC.

26 FORBES STREET, ROCHESTER 11, N.Y.

SPECIALISTS IN PROJECTION GAGING

"Flying" is for the slow dumb bird
who ain't been around, and hasn't heard
those **EAGER BEAVERS** go roaring by.
If one gives me a lift, I'll <u>really</u> fly.

REO MOTORS, INC., LANSING 20, MICHIGAN



ALCOA DEVELOPS NEW INDUCTION HEATING TO SPEED FORGING AND EXTRUSION OPERATIONS

Using ordinary household current, Alcoa engineers can now heat a billet of aluminum in 50 minutes instead of the usual 12 hours.

This development, representing 10 years of research, will speed production of big forgings and extrusions for military aircraft. The equipment consists of an induction coil operating on 60-cycle frequency. A 7,700-pound aluminum ingot can be brought to 750° F in this coil nearly 15 times faster than in a conventional furnace or soaking pit.

Installation and operating costs are no greater than for conventional equipment. Space requirements are considerably less. Other applications include annealing and heat treating fabricated products.

This is another example of the research and development which for 65 years has kept Alcoa first in aluminum, foremost in experience.

Aluminum Company of America, Dept. 850-G, Alcoa Bldg., Pittsburgh 19, Pa.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

★ Interchangeability

★ *the* TDA CO *key to better logistics*

Keeping an army on the move poses constant problems in vehicle maintenance and parts supply. TDA, working in close cooperation with the Armed Services to solve these problems, has developed the new TDA STRAIGHT-LINE DRIVE with top-mounted double reduction final drives for military vehicles with the greatest degree of parts interchangeability ever achieved.

HERE'S WHAT TDA PARTS INTERCHANGEABILITY MEANS TO MILITARY SUPPLY AND MAINTENANCE OFFICERS

1. A simpler logistics problem of stowage and palletizing.
2. Fewer different parts in stock bins—of vital necessity to the military supply officer who must maintain a warehouse on wheels.
3. Far greater ease of maintenance.
4. Fewer records of parts and service operations to maintain.
5. Reduced personnel training time in operation and maintenance.
6. More personnel made available for other duty.
7. Faster availability between manufacture and use.

For example, on the TDA-equipped 2½-ton 6x6 truck, final drives in *all three* axles are identical and interchangeable! There's only *one type* of shaft for *four* different locations. *One type* of housing for *two* different rear axle locations. *One type* of universal joint flange for *nine* different locations. To make a long story short, there are 22.8% *fewer different* parts in the running gear of the TDA-equipped 2½-ton 6x6 than the World War II truck of the same type!

Careful planning, sound engineering and close cooperation like this are helping to produce better military vehicles for a stronger America.

The Accepted TDA CO ® *Standard*

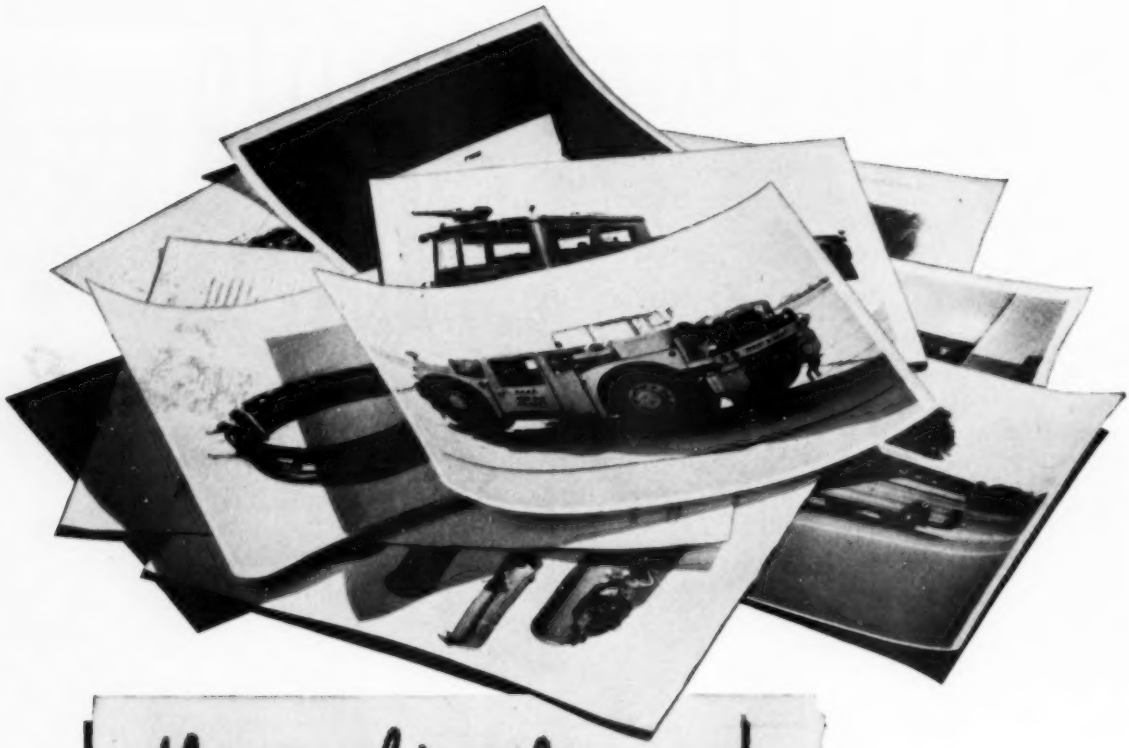
AXLES

THE TIMKEN-DETROIT AXLE COMPANY

Detroit 32, Michigan

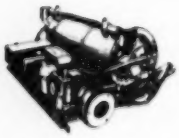
WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

PLANTS AT: DETROIT AND JACKSON, MICH. • OSHKOSH, WIS. • UTICA, N. Y. • ASHTABULA, KENTON AND NEWARK, OHIO • NEW CASTLE, PA.



the proof is piling up!

Janitrol liquid heater-equipped bomber tow tug starts reliably after 72-hour cold soak at minus 65°F, without special fuel capsules. Engine temperature raised to 155°F in 60 minutes . . . Heater specifications on Air Force crash truck met in full by Janitrol heater, which provides heat for defrosting, cab comfort, auxiliary generator, and main water supply . . . Stationary diesels winterized by Janitrol . . . Transit operators report Janitrol-equipped coaches run longer between overhauls, substantially reduce maintenance . . . The proof is piling up: that Janitrol heaters pay off the original investment in lower maintenance and positive, all-weather dependability.



"Janitrol liquid heater equipped" means dependability—proved for seven years

Janitrol

AIRCRAFT-AUTOMOTIVE DIVISION SURFACE COMBUSTION CORP., TOLEDO 1, OHIO

F. H. Scott, 225 Broadway, New York, N. Y. • C. B. Anderson, 2509 W. Berry St., Ft. Worth, Tex. • L. A. Curtin, 7046 Hollywood Blvd., Hollywood, Calif. • F. H. Scott 4650 East-West Highway, Washington, D. C. • Phil A. Miller; Frank Deak, USAF Coordinator, Central District Office, 400 Dublin Ave., Columbus, Ohio • Headquarters, Toledo, Ohio

GOVERNMENT FINISH SPECIFICATIONS

and the Parker Products which meet them

This list contains specifications most frequently called for, and some of the Parker Products which meet them. There are Parker Products to meet almost every one of the less frequently used government specifications also. A letter or telephone call to Parker, Detroit, will secure specific information on products to meet government specifications not listed here.

SPECIFICATION	PARKER PRODUCTS
JAN-C-490 (Replaces AXS-1245)	
Grade I	Bonderite 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
MIL-10578 (Formerly U.S.A. 3-213)	
Type I (Wash-off)	Parco Cleaner 250
Type II (Wipe-off)	Parco Cleaner 260
MIL-C-5541 (Formerly AN-C-170)	Bonderite 710 (chemical film for aluminum and its alloys)
MIL-C-16232 (BuORD)	
Type I	Parco Lubrite 1 & 2
Type II	Parco Compound
PA-PD-191	
Grade I	Bonderite 32, 34, 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
U.S.A. 72-53	Bonderite 32, 34, 100, 160, 170, 180
U.S.A. 57-0-2	
Type II	
Class A & A1	Parco Lubrite 1 & 2
Class B	Parco Powder—Parco Compound
Class C	Bonderite 100, 160, 170, 180

For information regarding these or other specifications, write

PARKER

RUST PROOF COMPANY

2165 E. Milwaukee Ave., Detroit 11, Mich.

FIRST IN THE FIELD SINCE 1915

Why Electron Tube Buyers do business with Tung-Sol®

Tung-Sol's modern manufacturing techniques and advanced quality control methods assure you of a product that is second to none. Tung-Sol makes tubes—no sets—no equipment—just tubes. Tung-Sol design, development and application engineers work closely together for the sole purpose of producing a better tube so that you can make a better product. Engineering assistance is strictly confidential. Tung-Sol service by competent field sales representatives is nationwide. A Tung-Sol delivery promise is a promise. Closest cooperation is maintained to keep deliveries up to your production schedule requirements.

TUNG-SOL ELECTRIC INC.

Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle

TUNG-SOL MAKES All-Glass Sealed Beam Lamps, Miniature-Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes.

ARE DRIVERS "RAILROADING" YOUR VEHICLES?

Handy Governors Will Stop It

Any driver is likely to be less than meticulous in his care of a vehicle he doesn't own. Many feel no compunction about "railroading" your vehicles. Drivers do most of their work away from supervision . . . abuses are hard to correct.

Handy Governor will stop "railroading"—stop practices which run up costs and wear out vehicles before their time.

The savings in tire, fuel, and lubricant costs, engine repairs, brake maintenance and general maintenance are spectacular. Reduced accident and insurance costs are equally important.

Let us show you some figures on savings—and tell you how little it costs to get them.

KING-SEELEY CORPORATION
ANN ARBOR, MICHIGAN
PLANTS AT ANN ARBOR, SCIO, YPSILANTI

HEIL SERVICE VETERANS

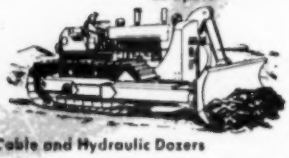
Heil Cargo Bodies

Heil Tailgate Lift

Heil Garbage Bodies

Heiliner 13 and 18-cu. yd. Scrapers

Heil Dump Bodies and Hoists


Heil Cable and Hydraulic Dozers

HEIL Quality PRODUCTS

Manufactured By
THE HEIL CO.
GENERAL OFFICES • MILWAUKEE 1, WISCONSIN
DEPT. R-73

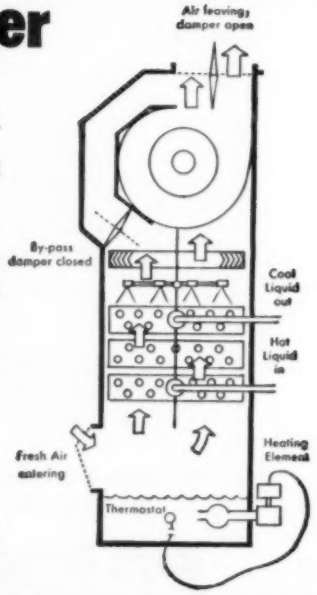
SEND FOR COMPLETE CATALOG

NIAGARA Aero Heat Exchanger

1. Extends quenching capacity without extra water or cooling tower.
2. Quickly pulls down heat at initial peak load of Quenching.
3. "Balanced Wet Bulb" Control holds quench bath at proper temperature, heating if needed to start after shut-down, and cools or heats by automatic control.
4. Saves cleaning expense as compared to cooling tower which picks up acids and fumes from air.

APPLICATIONS

Quench Oils
Cutting Oils
Lubricating Oils
Cooling Water



For help in increasing production, saving of cooling water, write for Bulletin No. 120. Address

NIAGARA BLOWER COMPANY
Over 35 Years of Service in Industrial Air Engineering

Dept. O, 405 Lexington Ave. New York 17, N. Y.
Experienced District Engineers in Principal Cities of U. S. and Canada.

TIN COCOON...

for the Ball
with the Armored Heart

Dust, dirt, moisture and other contaminants can ruin the fine finish on bearing balls in shipment or storage. Even the Ball with the Armored Heart isn't immune! That's why Abbott Precision-type Bearing Balls are normally shipped in sealed, lacquer-lined cans which keeps them safe and clean until their "tin-cocoon" is opened.

ONLY Abbott uses these protective cans as standard packing.

ONLY Abbott makes the Ball with the Armored Heart — the carbon steel bearing ball which is both DEEP HARDENED and TEMPERED to insure maximum shock resistance and load-carrying ability.

Want more details?
Write!

THE ABBOTT BALL COMPANY
70 RAILROAD PLACE
HARTFORD 10, CONN., U.S.A.

ABBOTT

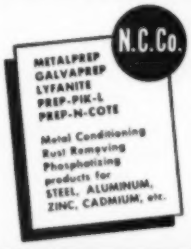
So You Don't Have Mechanical Cleaning Equipment, Eh!

then..

WIPE-OFF Metalprep

is Your Answer!

A MANUALLY APPLIED METAL CONDITIONING PRODUCT DESIGNED TO PERFORM THE FOLLOWING FUNCTIONS:



- **CLEANS THE METAL**
- **REMOVES THE RUST**
- **ETCHES THE METAL**

providing an anchor for your paint and a PHOSPHATE COATING for greater paint durability.

Also recommended for Spot Rust Removing after Mechanical Cleaning.

Send for Bulletin 50-34

EXCELLENT FOR LOW PRODUCTION AND BULKY EQUIPMENT

NEILSON CHEMICAL CO.
MANUFACTURERS OF METALPREP

3682 Tecumseh Road, Windsor, Ontario — 6580 Benson St., Detroit 7, Mich. — 3411 Union Pacific Ave., Los Angeles 23, Calif.

WE BELIEVE THAT A STRONG AMERICA IS A PEACEFUL AMERICA

MASON & HANGER COMPANY
SILAS MASON COMPANY

ENGINEERS
and
CONTRACTORS

Builders and Operators of
Ordnance Facilities

OFFICES:

500 Fifth Avenue
New York

Shreveport
Louisiana

Lexington
Kentucky

The Basic Shape Is Already Made When You Use Shelby Seamless

● You can do practically anything with a tube that you can do with a solid round bar—and you can save the cost of the hole.

Thousands of machine shops take advantage of this fact and produce high quality machined parts at savings up to 50% with the aid of Shelby Seamless Mechanical Tubing.

Boring and extensive machining can be minimized —sometimes eliminated—with Shelby Seamless. You save time, labor, materials, as well as wear and tear on expensive tools. You can often select just the right tube for your job, because Shelby Seamless is made in so many sizes, wall thicknesses, steel grades and finishes.

Whether you make one part, or hundreds or tens of thousands, the dependable uniformity of Shelby Seamless makes it possible to closely estimate your time, labor and material.

Our engineers will be glad to help you utilize the many advantages of Shelby Seamless for your product. Meantime, send for our free Bulletin Number 17. It may help you cut time and costs — and make a better product in the bargain.

All National Seamless Tubes are pierced from a billet of high quality steel. This is the one manufacturing method that assures absolutely uniform wall strength.

NATIONAL TUBE DIVISION
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(TUBING SPECIALTIES)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S SHELBY SEAMLESS MECHANICAL TUBING

USS

UNITED STATES STEEL

Cork-and-Rubber Gasket Materials

Armstrong manufactures cork-and-rubber gasket materials made to meet each class of the principal government specifications covering cork-and-rubber gasket materials.

Specification	Material
MIL-G-6183	
Type I Soft	NC-709
Type I Medium	NC-710
Type I Firm	NC-711
MIL-T-6841	(DK-153 (RK-3045
Type II Soft	DC-167
Type II Medium	DC-100
Type II Firm	DC-113
MIL-G-6747	DK-149

Write for samples and 24-page gasket design manual.

ARMSTRONG CORK COMPANY
2905 Arch St., Lancaster, Pennsylvania

Take a good look at this New Powerhouse*!

LOWEST COST per kilowatt!
HIGHEST OUTPUT per pound!
MOST COMPACT!

For standby, portable, mobile, stationary use

Whatever your need for electric power, the new Onan CW—5 and 10 give you top performance and value! Here, for the first time, are 5 and 10KW electric plants powered by revolutionary, new air-cooled gasoline engines, *designed and built by Onan exclusively for electric plant use.*

Both engines are 1800 R.P.M. Weigh much less than general-purpose engines. Amazingly compact. Two-cylinder, alternate-firing for smooth power. Built to deliver dependable service in heavy-duty use. New, quiet, highly-efficient vacuum air cooling drives out all heated air through *one* side vent, simplifying installation. Impulse-coupled, high-tension magneto ignition for quick starting under all conditions. Standard voltages 60-cycle A.C.

Write for folder and specifications

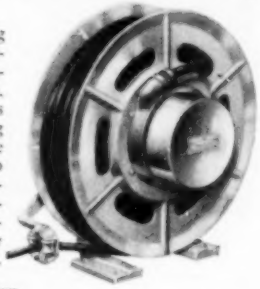
Onan ELECTRIC PLANTS

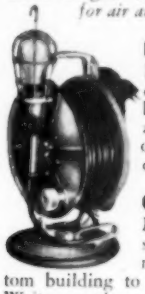
D. W. ONAN & SONS INC.
2877 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

NOW Faster, Easier Cable Handling

Spring-O-Matic

Improved ball-bearing, spring retractable POWEREEL handles up to 150' multiple conductor cable, sizes up to No. 4. Also for communications cable. Ratchet for stopping reel optional. Adjustable cable guide. Compact, easy to mount. Moisture and dust-proof. Simple, easy cable installation. Cast aluminum reduces weight. *Also available for air and fluid hose.*





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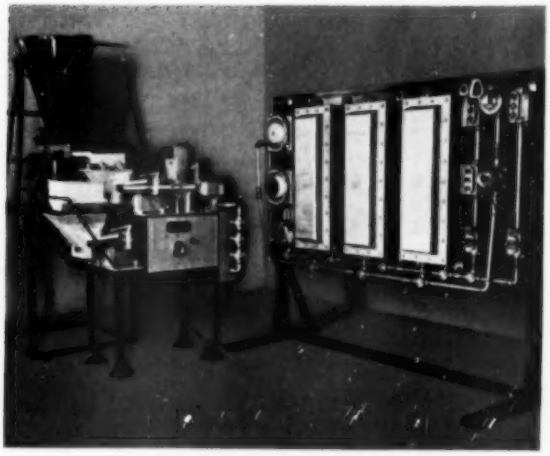

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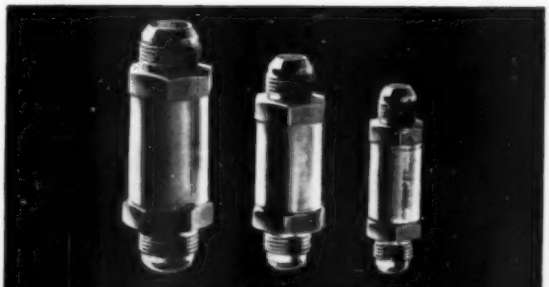

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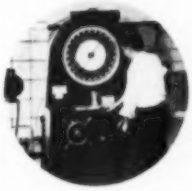

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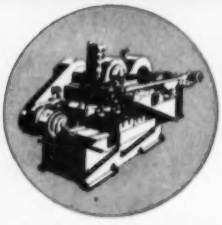

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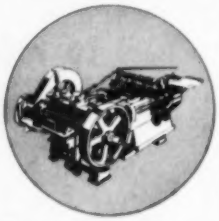

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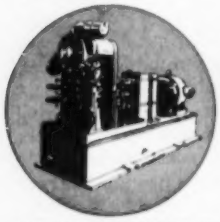

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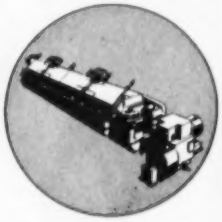

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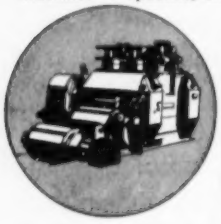

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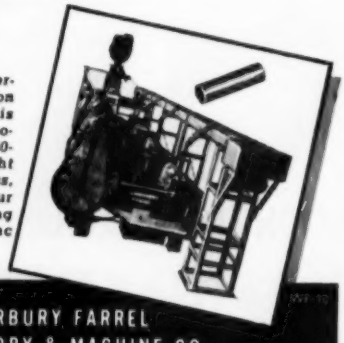

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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Taming Titanium

The Problem of Developing Good Alloys for Defense Needs

Lee S. Busch and Robert H. Dickinson

Metallurgists, P. R. Mallory & Company, Indianapolis, Ind.

TITANIUM has been considered to be a refractory metal and a "rare" metal. Its consideration as a refractory metal is based on its melting point of 3,137 degrees Fahrenheit.

A "Rare" Metal

Titanium was considered a "rare" metal, not because of its lack of abundance, but because of the difficulties in producing it in a pure form.

As an element, it is the ninth most abundant in the earth's crust. As a metal, it is the fourth most abundant—aluminum, iron, and magnesium being present in greater quantities.

Titanium was first discovered in 1791 by William Gregor, an English amateur chemist, in the black sands of Cornwall, England. In 1797, Klaproth (discoverer of uranium), a German chemist, found titanium in rutile ore. He named titanium after the Titans who were the "sons of the earth" according to Greek mythology.

The ores of titanium are rutile (titanium dioxide) and ilmenite (a ferrotitanate). Ilmenite ores are found in the Adirondack Mountains of New York, in Virginia, Wyoming, Arkansas, and in Florida. These ores are also plentiful in Canada, Japan, India, and in the Ilmen Mountains in Russia.

Ilmenite has been mined for many years for the iron content in the ore. Only during the last quarter century has the titanium been of any interest, and only during the past ten years has it been of major interest. Rutile, not as plentiful as ilmenite, is found in Virginia.

Titanium has been used for some time by metallurgists as an alloying element, principally in steel, and for cutting tools as titanium carbide. Titanium dioxide was isolated in 1908 and mass-produced in 1926 for paint and paper pigments. Its covering power and opaqueness are superior to all other white pigments.

Early in the twentieth century, Hunter produced the first metallic titanium pure enough to be ductile so that it could be cold-worked. The fact that purity and ductility were closely related was later confirmed by Kroll, Van Arkel, De Boer, and Fast who showed that small amounts of impurities, mainly oxygen, nitrogen, and iron, caused brittleness in metallic titanium.

Hunter's process for producing metallic titanium involved separating titanium from iron in impure oxide form and then treating the oxide with chlorine to form a volatile liquid, titanium tetrachloride. This was reduced with sodium to form titanium metal and sodium chloride.

New Process Successful

Kroll substituted molten magnesium for the medium and proved that the process could be utilized on a fairly large scale.

The reaction of titanium tetrachloride and molten magnesium takes place in an iron pot and results in a sponge titanium metal with magnesium chloride included. The magnesium chloride is removed by leaching with hydrochloric acid or heating in a vacuum, or both.

A process of thermal decomposition of titanium iodine on a heated surface was devised by Van Arkel. The titanium is deposited on a filament and the iodine liberated as a gas.

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A. R. Fultz

The metal produced is very pure and ductile but the process does not lend itself to large-scale production because of the equipment requirements and because it is in reality a refining process of low-grade metallic titanium which is used as a raw material.

The Kroll process is presently being used to produce commercial titanium metal sponge which is the melting stock or raw material for all large-scale melting operations. Total production in the United States at present is about five tons a day.

Japanese Production

Titanium sponge is being prepared in Japan by Osaka Special Steel for sale in the United States. This company expects to be able to produce metallic titanium sponge at a low enough price to make this possible.

Processes for producing metallic titanium by a hydride method and by electrolytic deposition from fused salts have been developed but have not produced titanium of as consistent quality or in as large a quantity as the Kroll process.

Commercially pure titanium and titanium-base alloys are currently being sold in sheet, plate, strip, wire, and bar form. The use to which these are being put is a matter of economics and military necessity.

The nature of titanium makes it difficult to melt. Above the melting point titanium will dissolve most materials. The presence of oxygen, nitrogen, or hydrogen causes embrittlement, and it is therefore necessary to melt in an inert atmosphere of argon, helium, or in a vacuum.

Ingots are produced by melting in a graphite crucible by induction heating or in a water-cooled copper crucible with an arc. Induction melting produces good homogeneous ingots after pouring into a mold but contaminates the metal with some carbon picked up from the crucible.

Arc-Melted Titanium

Arc melting produces ingots by progressively melting titanium and alloy additions. Ingots thus formed are not always sound or homogeneous. These ingots also contain some contamination from the electrode—tungsten or carbon—but, as a whole, arc-melted titanium and titanium alloys are purer, more ductile, and thus more useful.

The usefulness of titanium and its alloys becomes apparent after a study of the strength-versus-density ratio at various temperatures. At temperatures above 300 degrees Fahrenheit the aluminum and magnesium alloys lose strength to such a point that their replacement by titanium alloys where high-temperature strength-weight ratio is important is obvious.

Strength-weight ratios at elevated temperatures are important, principally in jet-engine design where weight, strength, temperature, and resistance to corrosive gases are always important.

The properties of titanium alloys lend themselves for use as compressor disks, blades, and stators, compressor and turbine liners, and sheet-metal parts in jet engines.

Other possible aircraft uses include rivets, bolts, arresting gear, hooks, engine-nacelle skins, landing-gear forgings, skin and tail assemblies in missiles, crankshafts and connecting rods in internal-combustion engines, rocker arms, gears, bearing housings, and channels, frames, and angles of sheet.

Redesign Required

The majority of these uses are on an experimental basis, but to take full advantage of the properties of titanium alloys redesign of most parts or the redesign of the whole unit would be necessary. The experimental uses are, therefore, in the most part, places where substitution could be made for aluminum, magnesium, or steel without excessive design changes.

These substitutions were made not only to determine the applications for titanium alloys based on their properties but to determine the fabrication techniques that would be required if and when titanium parts are used.

Experimental 32- by 8-inch forgings cast from MST 3A1 5 cr. titanium alloy.

Difficulties continually occur throughout the refining, melting, hot-working, machining, forming, and joining operations in the manufacture of titanium parts.

Cause of Difficulties

Many of these difficulties are due to the chemical and physical properties of the metal. Many are due to the lack of basic metallurgical knowledge which is available for other materials but not available for titanium due to the industry's recent and rapid growth.

Data that have been published in circulars and handbooks for many years for alloy steels and nonferrous alloys have yet to be determined on titanium alloys because of this rapid development.

The refining and melting processes are limited in size and ease of operation by the chemical activity of the metal in the molten state and at elevated temperatures. The toughness of titanium alloys often makes hot- and cold-forging or rolling difficult.

Titanium alloys work-harden, have a tendency to gall or smear, and the titanium carbides that may be present are very abrasive—all of which make machining difficult. Forming of sheet parts often requires heat.

Welding and brazing are possible but the ductility of the joint is usually below what would be considered acceptable. It is these difficulties that often limit the use of titanium alloys.

Steam Hammers Used

Forging is usually done on steam forging hammers using oil- or gas-fired furnaces to heat the metal. The ingot should be placed on clean bricks and contact with mill scale avoided.

The ingots, conditioned by scalping or grinding after melting, are heated to a forging temperature of 1,650 to 2,000 degrees Fahrenheit, depending on the composition of the ingot and its size. Heating must not be too rapid on large ingots due to the low thermal conductivity of the metal.

Forging reductions are as great as possible between each heat to prevent excessive grain growth and reduce total furnace time. At present the forging

alloys are 2-phase structures, and hot-working takes place in a 2-phase region. Desirable properties are obtained by heat treatment after forging.

Very little cold work can be done on the high-strength alloys and, therefore, minimum forging temperatures have been established for the various alloys. Both flat-die and closed-die forgings can be made. Die cavities fill quite readily but greater draft angles are required than those used for steel.

Hot- and Cold-Rolling

Both hot-rolling and cold-rolling can be done on titanium and its alloys. The hot-rolling temperatures are between 1,300 and 1,800 degrees Fahrenheit, depending on the titanium alloy being rolled and on the type of rolling being done. The rolling of sheets of uniform quality depends greatly on the uniformity of all steps in the rolling operation and in the care taken to maintain a clean surface free of surface flaws and heavy uneven oxide scale.

The rolling of titanium alloys requires greater pressures than are normally required for other metals. The rolling operation is followed by annealing, descaling, and pickling and often a cold-skin pass to produce a desirable surface.

The rolled sheet is being substituted for stainless steel in airplane fuselage sections where strength at temperatures above 300 degrees Fahrenheit, the limit for aluminum, is required.

Cold-pressing is not practical because of poor surfaces that develop. Pressing at 800 degrees Fahrenheit is possible with little wrinkling of the surface. Bend radii of 1.5T have been obtained.

Parts may require forming in stages with intermediate annealing and some hand finishing to remove press-formed wrinkles. The hand-finishing operation may be avoided if dies are designed for internal heating. Springback angles of 5 to 16 degrees have been encountered depending on the material and the pressing technique.

Use Discouraged

The use of special-purpose machine tools on titanium and titanium alloys without proper experimentation with the machining characteristics of the metal has often discouraged the use of this metal in machined parts.

Machining is difficult, and special precautions must be taken to machine titanium alloys properly and economically. Because of this the additional machining costs have and will limit the use of forgings until the knowledge about machinability is comparable to that of other metals.

Direct substitution in aircraft-engine parts is a matter of economics. Titanium parts cost from three to ten times as much as the materials substituted for. The substitution of titanium for alloy steel amounts to about one hundred per cent increase in material cost and increases in the cost of fabricating and machining.

Costs Can Be Reduced

All these costs can be reduced through a more thorough knowledge of titanium metallurgy. Material costs will decline as titanium finds more uses. Fabrication costs are high because little is known about what occurs during all fabricating procedures. Machining costs will be reduced when titanium is machined with a full knowledge of its machining characteristics and on a full scale rather than as a substitute metal.

Because of the desirable properties of titanium alloys and the tremendous amount of work being put into the development of an inexpensive melting stock, melting methods, alloy exploration, and fabricating methods, it is possible that reductions in all costs will result in the near future.

It is apparent, however, that at present the advantages in weight saving must overbalance the increased cost wherever titanium is used.

Property	*Unalloyed*	*As Forged High-Strength Alloy*
Density (lb./in.^{3})	0.162	0.166
Melting point	3,137° F. (1,725° C.)	——
Transformation temperature	1,620° F. (882° C.)	1,200° F. to 1,650° F.
Thermal expansion (inch/inch/° C.)	8.5×10^{-6}	9×10^{-6}
Electrical resistivity (microhm-cm. at 20° C.)	55	150
Ultimate tensile strength (p. s. i.)	80,000	165,000
0.2% offset yield strength (p. s. i.)	72,000	155,000
Proportional limit (p. s. i.)	45,000	125,000
Elongation in 2" (%)	25	7
Reduction in area (%)	55	25
Modulus of elasticity (p. s. i. $\times 10^6$)	16	18
Hardness (Rockwell "A")	58	70
Fatigue strength (p. s. i.)	55,000	95,000

Table above shows physical properties of titanium in pure and alloyed states.

Basic Reason for Use

This is the basic reason for its use in aircraft rather than in many places where the advantage in weight saving does not warrant the additional cost. At the time when production is large enough and prices are low enough to use titanium alloys to their fullest advantage, its corrosion resistance to salt water and chemicals may prove to be as much an advantage as its strength-weight ratio.

In order that titanium-base alloys may be applied to all types of structures, alloys have been and are now being developed so that strengths of 55,000 p.s.i. to 200,000 p.s.i. can be obtained.

New Alloys

Alloys are being developed with the idea of obtaining the desired tensile properties and with good forgeability, rolling characteristics, weldability, formability, and machinability.

Recent metallurgical studies in the establishment of time-temperature-transformation diagrams have greatly increased the knowledge of the metallography and effects of heat treatments on alpha-beta titanium alloys. These heat treatments increase the potential uses of the alloys currently available and help in the development of alloys that will better fit current and future needs.

As an element, titanium is the ninth most abundant in the earth's crust. As a metal it is the fourth most abundant, being next to aluminum, iron, and magnesium.

The mobile gun, above, is protected from moisture and corrosion by an air-tight metal covering equipped with silica gel solar radiation breathers.

Protective Packaging

New Dehydration Methods of Storage Help to Protect Reserve Equipment

D. N. Hauseman

THE present stockpiling phase of the military procurement program, added to extensive overseas shipments of materials, inevitably increases the relative importance of packaging for protection against moisture damage.

Rapid Development

Extensive experience during World War II with dehydrated, or "Method II" packaging, as it is usually termed, and research since then by the armed services and industry in close coöperation, have brought rapid development in precision and technique.

A new standard of specifications covering the use of desiccants in packaging is of relatively recent origin, and new protective devices and improvements in packaging materials have come rapidly.

The advent of jet engines and guided missiles has brought about the use of larger "packages" than ever, but the principles followed are the same regardless of size.

The utility of the packaging method was well established in a survey made after World War II of some 482 packages which had been in storage at Ordnance depots located throughout the United States. Of all the packs opened, only 0.2 per cent showed signs of moisture damage, and the average relative humidity maintained in all the packages was 13.85 per cent for an average package age of one year, three months.

It was established that the typical package, sealed and protected according to specifications, would maintain a relative humidity of thirty per cent or less for approximately six years.

These findings are significant in the light of other tests which demonstrated beyond doubt that packaged materials or mechanisms would remain free from rust and corrosion if stored in an atmosphere in which the relative humidity is kept at forty per cent or below. Protection from mildew, mold, and fungus is effected by storage at sixty per cent relative humidity or below.

Sealed Barrier Used

Method II packaging maintains the desired low relative humidity by containing the material to be protected within a barrier which is sealed against the entrance of moisture vapor. A desiccant or drying agent, such as silica gel, is incorporated within the barrier; it adsorbs water vapor which may be present at the time of sealing or which subsequently diffuses through the barrier.

The amount of desiccant needed to protect a package of a given size for a specified period of time is known precisely and can be calculated from the specifications.

Silica gel is itself a product with a military history which goes back to World War I when it was developed by Dr. Walter A. Patrick of the Johns Hopkins University, Baltimore, in response to needs of the Chemical Warfare Service. Continuous research has perfected the product.

Porous Structure

It is a synthetic form of silicon dioxide which is chemically similar to sand but entirely different physically. Its hard granules have an extremely porous structure and are considered to contain millions of tiny tunnels which attract and hold water vapor by adsorption (a surface phenomenon) and capillary attraction.

With this structure, silica gel has a tremendous relative surface area, one cubic inch of Protek-Sorb, the grade which Davison Chemical Corporation has developed for dehydrated packaging, having an estimated 90,000 square feet of surface.

The product can adsorb approximately forty per cent of its weight in moisture vapor from saturated air. In doing so it remains perfectly dry in appearance. It is chemically inert, never

General Hauseman served in the Army Ordnance Corps in both World Wars. He retired from active duty in 1946 and is now vice-president of the Davison Chemical Corp., Baltimore, Md.

becomes damp or deliquescent, and will not attack metals, alloys, or other materials.

Unit Established

In the recent military specification MIL-D-3464, which covers desiccants for static dehumidification and packaging, a "unit" of desiccant is established as a standard of use in packaging. A unit is that weight of desiccant which at 25 degrees Centigrade will adsorb at least 3 grams of water vapor at 20 per cent relative humidity and at least 6 grams of water vapor at 40 per cent relative humidity.

MIL-D-3464 specifies that desiccants be available in bags ranging in size from 1/6 of a unit (approximately 4 grams of silica gel) to 16 units (approximately one pound of silica gel). The smaller bag sizes are usually of the heat-sealable variety, similar to small packets of sugar, whereas the larger sizes are usually sewn, and have strings for tieing them to pieces of equipment.

Two basic bag materials are presently in use: cotton cloth or gauze, lined with fine paper or fibrous web to prevent dusting; and nondusting paper or nonwoven cloth. The former type is called Class I for general-purpose use, whereas the second type is called Class II and must meet rigid specifications against dusting.

In all probability all bags of the future will be the Class II type since this material is fairly inexpensive and is superior in nondusting qualities to the conventional Class I material.

The larger sized bags are usually furnished in 20-gallon drums; the smaller sizes in 1-gallon and 5-gallon cans and 20-gallon drums.

Details Covered

Complete details of the methods and materials used for military Method II dehydrated packaging are covered in MIL-P-116B. This specification, which can be procured from the U. S. Government Printing Office, lists pertinent specifications covering desiccants and barrier materials, as well as other items necessary for packaging. In general, the methods used by the military services can be applied to commercial packaging with little or no change.

There are two basic types of dehydrated packages: (1) Rigid containers such as glass jars, metal cans, and drums which are well sealed against infiltration of moisture vapor by a rubber gasket or by hermetically sealing, and (2) packages other than rigid containers in which the package is protected from infiltration of atmospheric moisture vapor by the use of a vapor-barrier material which completely surrounds the package.

The desiccant requirements for protection in a *rigid container* for a minimum of eighteen months at a relative humidity of forty per cent or below can be calculated by using the following formula: $U = KV + 10D$.

For packages using flexible barriers, a larger amount of desiccant is required because of the slow infiltration

Above, close-up of a solar radiation breather. Dehydrating agent is reactivated daily by heat of sun's rays.

of moisture through the barrier materials which are never as perfect as the rigid containers. The following formula applies *for flexible barriers:* $U = 1.6A + 10D$, where U equals the number of units of desiccant required, A the area of barrier in square feet, D the pounds of dunnage within the barrier. K equals 0.0007 when the volume is given in cubic inches, or V equals the volume of the container in cubic inches or cubic feet.

It should be noted that the area (A) is the area of the entire flexible barrier.

Table Worked Out

To compute quickly the amount of desiccant required for a package of a given size, a table has been worked out, based upon the formulas for both rigid and flexible barriers for a number of sizes of packages.

This table does not include the use of dunnage or overpacking in the package. If dunnage such as cotton, paper, or wood is used, extra units of desiccant must be added equivalent to ten times the weight of dunnage.

As an example, take a rigid container such as an eighty cubic foot metal drum which contains four pounds of dunnage. Reference to the table indicates that 101 units of desiccant are required for 80 cubic feet, to which must be added 10×4, or 40 units to compensate for the dunnage. Hence the total desiccant required is 141 units.

Another Example

As a further example, let us assume a flexible package that is 36 inches by 30 inches by 10 inches in size. The total surface area is 3,480 square inches, which requires 39 units of dessicant.

Let us further assume that a half pound of dunnage is required. Hence, to the 39 units of desiccant must be added $10 \times \frac{1}{2}$ or 5 units to compensate for the dunnage. The total desiccant therefore required is 39 plus 5 or a total of 44 units.

The choice of the moisture-vapor barrier wrapping material is important since the vapor transmission rate determines the amount of desiccant required to protect a package for a given period of time. Present-day moisture-vapor barriers used with Method II packaging usually consist of a laminated sheet composed of a metal foil laminated to polyethylene with a scrim cloth or paper backing and a heat-sealable coating.

New Specification

Specification MIL-B-131A on barrier material now supersedes JAN-B-131. The three classes of barriers originally specified in JAN-P-131 are eliminated and replaced by Class A, Class B, and Class D barriers, all of which have a maximum MVTR of .05 gram/100 square inches/24 hours.

A basic rule in all packaging is that the parts must be clean. No corrosion-prevention method, not even Method II packaging, can protect dirty parts. Typical examples of objectionable foreign matter are: perspiration from handling, residual soldering or brazing flux, residues from cooling and machining operations, residual heat-treating salts, general factory contamination from dust and chemical deposits, and residues from marking inks or etching solutions.

Detailed information on various types

of cleaning materials and procedures is given in MIL-P-116B. A frequently used cleaning schedule is: (1) petroleum solvent, (2) fingerprint removing agent, (3) dry, (4) preservative.

Rules Summarized

The fundamental rules to insure success in Method II packaging may be summarized as follows: (1) Clean the unit thoroughly before packaging. (2) Select for the moisture barrier the most moisture-impervious material which is applicable to the specific package. (3) In the design of the package keep the hygroscopic dunnage to a minimum. (4) Make sure that all joints and seams in the barrier are moisture impervious. (5) Design the barrier so that it will have the minimum surface area consistent with its application. (6) Use an adequate amount of desiccant. (7) Use only activated desiccant that has not been exposed to the atmosphere.

Military requirements specify that humidity-indicator cards be incorporated in all Method II packages unless otherwise specified. Two types of indicator cards are available: AN-7511 (5 x 8 inches) and AN-7513 (1½ x 4 inches). The cards are envelopes containing blue indicating silica gel which changes from blue to pink as the relative humidity increases from twenty per cent to sixty per cent.

Many Applications

The cards also can be used as a combination indicator-dehydrator since the silica gel will adsorb moisture as well as indicate. For that reason they find many useful applications where a small amount of drying is required and where it is also necessary that an indicating agent be present.

The indicating silica gel must comply with MIL-D-3716 which supersedes JAN-D-169 and AN-D-6C for dynamic dehumidification.

Recently, a new type of inexpensive humidity indicator card with "Tel-Tale" spots has been introduced. The spots change color very rapidly and indicate relative humidity reliably. This type of indicator has been approved by the Air Force and Signal Corps and is under consideration for approval by the other services.

One type of card has three spots which change from pink to blue or vice versa with changes in relative humidity. The composition of the spots is adjusted so that one spot changes color at 65 per cent relative humidity, another changes at 40 per cent, and the last at 30 per cent. Each spot has an accuracy of plus or minus 5 per cent relative humidity. Another type of card has six spots graduated from 10 to 60 per cent.

The cards are 4 x 2 inches and are furnished with eyelets to permit tieing them to equipment. Although the cards will probably prove satisfactory for most purposes, it should be mentioned that the colored spots contain cobalt chloride which can be corrosive if placed in direct contact with ferrous metals. Complete specifications are shown on U. S. Air Force Air Matériel Command drawing 52B22849.

The utility of dehydrated packaging was established in a survey made after World War II. The typical package, sealed and protected according to specifications, would maintain a relative humidity of thirty per cent or less for approximately six years.

The Method II military package remains essentially as it was at the close of World War II. JAN-P-116 entitled, "Packaging and Packing for Overseas Shipment," has been superseded by MIL-P-116B which includes performance tests not previously covered in JAN-P-116. The net result is greater flexibility in packaging operations in addition to assurance of optimum performance.

Rigid Barrier Used

For jet engines and guided missiles the rigid barrier is generally used since it affords physical strength as well as protection against moisture and has the added feature of buoyancy in water. Because of the high cost of the mechanisms, the fabrication of special rigid containers for this protection is readily justifiable.

A new type of indicator is under development by The Davison Chemical Corporation. This indicator consists of a glass "bull's-eye" filled with indicating silica gel. The bull's-eye is equipped with gaskets and metal fittings which permit it to be fastened to a nipple welded to the container shell. A tight seal against moisture infiltration is thus provided, but air within the container can diffuse freely through the indicating gel thereby affording an easy visual means for determining humidity conditions within the container without opening it.

Another recent development is a change in Navy Bureau of Ordnance specifications to provide for inclusion of two unit bags of desiccant in metal containers for military pyrotechnics—night drift signals, marine markers, and aircraft float lights.

New Breathing Device

At the close of World War II, the Davison Chemical Corporation in cooperation with Army Ordnance developed a silica gel solar radiation breathing device which could be placed on the top of aluminum housings in which fairly large weapons were stored for an indefinite period of time.

These breathers, installed approximately six years ago, are undergoing tests at the Aberdeen Ordnance Depot and have proved capable of maintaining a relative humidity within the housing as low as twenty per cent.

Simple Principle

The radiation breathers work on the very simple principle of regeneration by heat from the sun's rays. As the air within the housing expands, it is forced through the silica gel contained in the breather to the atmosphere.

The moisture is released from the silica gel during the day by the heat of the sun and the hot air passing through the bed sweeps out the moisture vapor, thus reactivating the silica gel. At night, when the air cools in the housing, it shrinks in volume and thus draws air from the outside through the silica gel into the housing.

Silica Gel Reactivated

Since the silica gel has been reactivated during the day, it is in a condition to adsorb sufficient moisture from the night air to maintain a low relative humidity within the container housing the matériel.

With these and other improvements in dehydrated packaging and related practices, it is clear that the Nation's mounting store of military materials will be amply protected from moisture damage for their entire useful military life.

Ammunition Supply and Fire Direction Centers

Col. John D. Byrne

THE light field-artillery battalion within the infantry division is the keystone of artillery, naval gunfire, and close air support. This battalion, the 105-mm. howitzer outfit in direct support of an infantry regiment, must constantly follow the maneuver plan of each of the regiment's rifle companies and must coördinate the accuracy and timing of its fire with each infantry skirmish.

"Safe-to-Fire" Line

It seems to me, therefore, that this artillery battalion should be thought of as an indispensable part of the infantry regiment in battle because it plots the safe-to-fire line that must be used by all heavy support weapons. The safe-to-fire line is the latest tactical picture across the front of the infantry regiment.

And right beside this tactical picture in the light artillery battalion's fire-direction center is the record of the type and quantity of ammunition fired in support of each small-unit fire fight.

Actually, then, the direct-support field-artillery battalion is a keystone both in tactics and supply. The battalion's record of ammunition fired, if coupled with the tactical information of the safe-to-fire line, should be vital to the procurement people; that is, the rate of manufacture of standard weapons depends upon exact knowledge of front-line use.

Because of the lead time necessary to convert a battlefield need into a weapon in the hands of the troops, supply and demand will never exactly match. It should be possible, however, partially to close the gap.

More Vigorous Use Urged

As the first step in closing this gap I advocate a more vigorous use of that well-organized and well-equipped outfit, the direct-support field-artillery battalion. Specifically, each howitzer battery of that battalion should fire a family of weapons in addition to the 105-mm. howitzer; for example, 4.2-inch and 155-mm. mortars and 4.5-inch and 7.2-inch rockets. This proposal does not include the 60-mm. and the 81-mm. mortars or any direct-fire weapons such as tank guns, machine guns, or recoilless rifles.

I simply believe that the weapons suitable for close-support indirect fire should be put under the existing control resources of the light-artillery battalion.

With the wisdom of hindsight we can say that the greatest area for improvement of the heavy indirect-fire system is at the foxhole level—in the regimental combat team of infantry regiment and field-artillery battalion. Recent experience has divided the mission of direct support, formerly the undivided rôle of the direct-support artillery battalion, among a number of other weapons units—units usually attached to the infantry regiment.

Reasons Given

Actually the division was brought about for good and sufficient reasons—the terrific load imposed on our infantry regiments during World War II; the postmobilization appearance of many new weapons; and the late-in-the-war diversion of air, antiair, and antitank forces to their secondary rôle of direct support.

But it is now time to point out that permanent division of the direct-support mission would be wasteful of ammunition resources clear back to the factory.

In my opinion, therefore, direct support should again be unified as the mission of the direct-support field-artillery battalion.

Division of the primary function of direct support—combat intelligence—is dangerous, if not impossible. The direct-support field-artillery battalion is, simply stated, a front-line Federal Bureau of Investigation. This organization maintains agents (liaison officers and forward observers) at infantry regimental, battalion, and company headquarters.

It improves their operations by establishing additional observation posts and army light aviation in the regimental sector, and it knits together the reports of all these agents with that fine survey instrument, the 105-mm. howitzer.

That is, the howitzer locates any point that it has fired on within ten yards or so. An artillery survey ties the gun data to map coördinates.

Thus does the artillery "FBI" assemble a picture of the latest enemy activity, coupled with the plans and locations of the supported infantry regiment. This latest news of friend and foe determines the safe-to-fire-line.

No indirect-fire unit can shoot efficiently in the regimental sector unless it leans heavily on the combat intelligence produced by the direct-support artillery.

S-2 Function Divided

Of course, combat intelligence cannot be directly divided. In practice, the attachment of assorted weapons units to the regiment divides the artillery S-2 function by splitting communications resources, especially radio frequencies.

And radio frequencies are the heart of direct-support communications because tactical emergencies usually coincide with poor or disrupted telephone systems.

Each indirect-fire unit that would

Colonel Byrne is a member of the Department of English at the United States Military Academy, West Point, N. Y.

support a regiment requires a minimum of four radio channels—at least one for each supported infantry battalion sector and at least one for interior fire control.

But there is a serious probability that four radio channels per direct-support field-artillery battalion cannot be provided in theaters employing large numbers of troop units.

Pressing Reason

This scarcity of radio channels, therefore, is the most pressing reason again to unify the direct-support mission under the artillery battalion of the regimental combat team.

A parallel division occurs in the supply of ammunition, the shock instrument of indirect fire. Under attachment, command control is supposed to go to the infantry commander because the attached units are directly under his thumb. But, in the case of heavy indirect-fire weapons, attachment does not mean control; attachment means only the authority to expend the ammunition actually in the hands of the attached units.

For the minute the infantry commander—company, battalion, or regimental—starts to deal with a committee of liaison officers from attached weapons units, true control of heavy support fire passes to the officers of division, corps, and task-force G-4's. In other words, the G-4's, matching 24-hour-old expenditure reports with available ammunition and transport resources, are the only persons who can find out the sum of the blank checks filled in by the liaison officers during the previous day.

Unhealthy Condition

Thus we see that the system of "attachment" and "G-4 control" produces an unhealthy condition in the command, staff, and communications of the regimental combat team. For if there are several attached heavy indirect-fire units, the infantry staff and communications must take on more and more artillery work to coördinate them.

At the same time, the artillery resources provided for the purpose do less and less. Furthermore, G-4 control soon means rationing of artillery ammunition since it is easier to impose a limit through the system of Fire Direction Centers than it is to contact individual, widely deployed indirect-fire companies.

Consequently, the rationed artillery loses the "feel" of the heavy fire fight and hence is less able to give the traditionally excellent artillery combat intelligence to the infantry regimental commander.

Good management demands that the infantry regimental commander have a single firepower agent to deal with. Further, that agent must have the resources—staff, communications, observation, survey, liaison, and guns—to match priority of targets with available ammunition and fuel.

The solution is to have the direct-support artillery battalion fire all heavy indirect-fire weapons within the combat team. Then the artillery battalion commander becomes, in fact, the combat team artillery officer.

This solution takes the artillery load off the infantryman's back and gives him his single firepower agent.

Gains Enumerated

As soon as the regimental commander makes full use of his artillery officer he gains: (1) A single agency to handle firepower; (2) Full use of his infantry staff and communications to control the rifle units; (3) An integrated combat intelligence picture assembled by artillery-observation and communications resources; and (4) A continuous report of the amount and type of ammunition used for each close-support fire mission.

A Table of Organization change in the direct-support artillery battalion is necessary if it is to fire a family of weapons. A special-weapons platoon should be added to each of the three 105-mm. howitzer batteries of the light battalion.

Special Weapons Platoon

A special-weapons platoon would train much like a combat engineer platoon, except that the emphasis would be on weapons instead of construction. That is, the artillery battalion would train three versatile platoons to fire a family of weapons; for example, 4.2-inch and 155-mm. mortars and 4.5-inch and 7.2-inch rockets. The weapons and ammunition would be drawn from supply depots as needed for the situation.

Artillery observation and liaison parties could adjust the fire of any weapon in the hands of the special weapons platoons; the radio channels formerly necessary for attached weapons units would be available to help the light artillery battalion to retain its minimum of four channels; and the present problem of coördinating attached weapons units with the light artillery battalion would disappear.

Indirect-Fire Jobs

Stated in another way, the artillery battalion plus its special-weapons platoons would take over all jobs requiring the attachment of an indirect-fire-weapon battery or part of a battery to the infantry regiment.

A 4.2-inch mortar in action in Korea (Army photo).

Tactically, such a reënforced artillery battalion would reduce the clutter of stray vehicles, reconnaissance parties, and small command posts in forward areas. In addition, a stronger direct-support battalion would add to the combat team's shock power and depth. For in the opening seesaw of a major war, the artillery may well have to engage in an occasional fire fight to execute its support mission.

Can a light-artillery battalion fire all heavy weapons in the regimental sector? As an observer of a few busy afternoons in a direct-support fire direction center, I can say that the present difficulty of the light-artillery commander is responsibility without control.

"Attached" weapons support shoots up the available ammunition, cuts into the number of radio channels available for artillery, and lacks the means collectively to plot all fire missions as a "safe-to-fire" line.

Resultant Simplicity

My recommendation to use assorted weapons within one battalion will undoubtedly bring complexities of supply and training to the direct-support artillery. But this broader mission will also bring a resultant simplicity to staff, communications, and command within the whole combat team.

A little experience with the broader mission will, I predict, bring a much-needed emphasis to the 105-mm. howitzer battery as a unit of direct support. The light battalion, like nearly every other tactical unit, has a triangular organization—three howitzer batteries. Given adequate communications, any one of the three howitzer batteries in the combat team artillery battalion can take over the battalion mission in an emergency.

Present artillery gunnery techniques will enable such a battery to gather intelligence, to adjust on enemy locations, and to call for additional artillery, naval gunfire, or close air support.

For the artillery, this potential of the 105-mm. howitzer battery reduces the danger of too much dependence on the fire-direction center.

Ideal Instrument

Thus we see that the light field-artillery battalion, with each of its howitzer batteries able to take over the battalion mission in an emergency, is the ideal instrument for matching tactical needs to available ammunition.

The light artillery needs only to receive adequate radio channels, weapons crews for mortars and rockets, and vigorous use by infantry commanders.

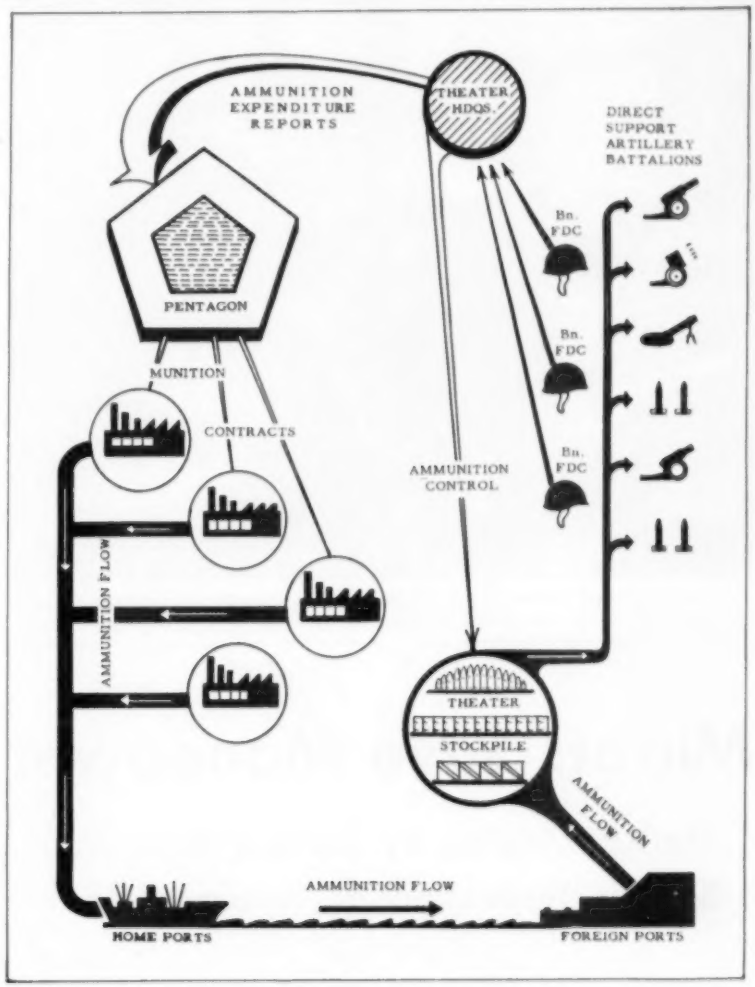
As the theory of the new fire support coördination centers develops, the keystone nature of the direct-support artillery will again emerge; that is, the proper use of naval gunfire and close air support depends upon the efficient intelligence collection, communications, and gunnery of the light artillery.

In the larger sense, this matching of tactical needs with ammunition supply will produce the statistics vital to the procurement and shipment of the right weapons in the right quantities.

Questions Posed

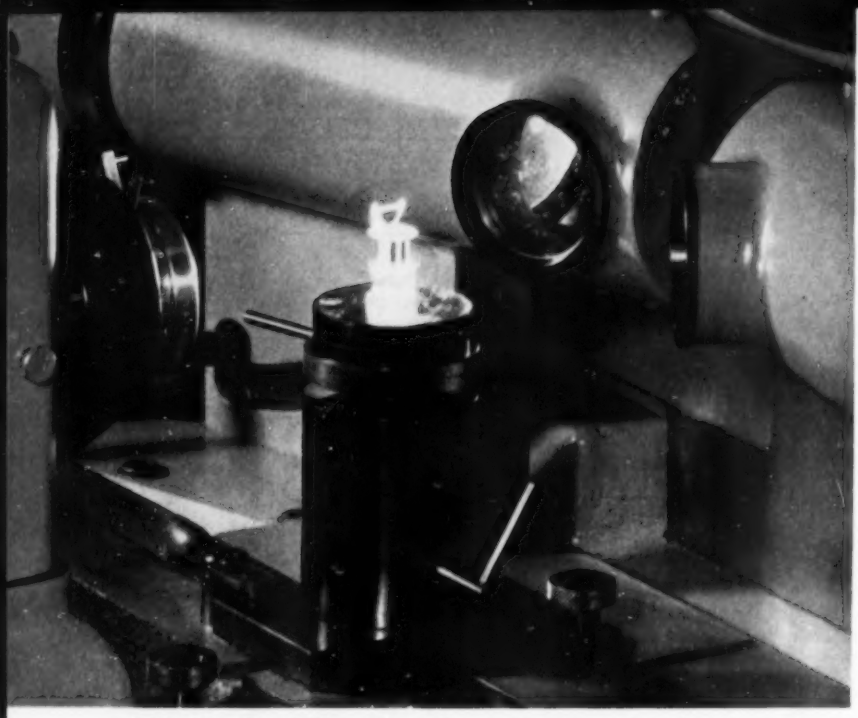
Perhaps these statistics will provide answers to qualitative questions: What is a certain weapon good for? Which weapons provide the best effect for the least expense in propellants and fuel? Which munitions are cheapest to transport?

The unified direct-support artillery mission is clearly the key to the precise battlefield aim of our vast industrial might.



The flow of artillery ammunition from factory to firing line.

The author is indebted to Col. R. K. Alspach, Professor of English, United States Military Academy, for criticizing the draft of this article and to Col. D. E. Breakefield of the Department of Ordnance, U.S.M.A., for discussion of the technical points. The chart on this page was drawn by Lieut. Col. E. W. Jacunski of the Department of Military Topography and Graphics at the Military Academy.



Light from three 1,000-watt lamps focuses on vacuum tube, reflects from tube elements, and forms magnified, full-color image of tube components on study screen.

Mirrors Save Manpower

Optical Gaging by Contour Projection Speeds Inspection of Precision Parts

A. R. Fultz

EVERY day industry is finding new ways in which optical gaging can save valuable technical and highly skilled manpower.

Do It with Mirrors

Gage engineers are now learning that, if they include a pocketful of mirrors among their optical-gaging equipment, they can widen and extend the applications of this valuable new technique still further. For mirrors are making it possible to apply optical gaging to jobs and processes that used to be considered outside its scope.

Ordinarily, optical gaging is accomplished by comparing an enlarged shadow image of a mechanical part with a chart gage superimposed on the projection screen of an optical comparator. However, a modification of a mirror in the comparator's optical system makes it possible to supplement the shadow-projection system with a surface illumination feature. This consists of an additional light source within the optical comparator, the light from which is directed through a hole in the center of the mirror onto the surface of the part being checked.

Reflected light then passes back into the lens system of the comparator and is enlarged and projected on the screen (Fig. 1). The versatility of optical gaging is greatly expanded by this use of mirrors. Optical comparators now are available with this feature as standard equipment.

Ingenious Use

One of the ingenious uses of mirrors in extending the applications of optical gaging is in converting the surface illumination beam into shadow illumination. This is done in inspecting a peripheral cam. For this job, the cam is positioned on a shaft, at the other end of which is a glass disk. On that disk the nominal outline of the cam, and maximum and minimum tolerance lines, have been scribed.

As the cam is rotated, a follower on a ball-bearing slide moves back and forth. A glass plate, on which the outline of the follower has been scribed, is attached to the slide directly back of the glass disk which carries the outline of the cam.

Beam Reversed

It is not possible to project past the metal cam and the follower in the normal manner, but, by placing a mirror behind the glass disk and the glass follower, the surface illumination beam is reversed, projecting the outline of the follower, the nominal cam contour, and the tolerance limits all on the screen together (Fig. 2).

Using this method, by simply rotating the shaft an unskilled operator can quickly determine whether the test cam is within the limits and can even estimate how much it departs from the nominal at any point on its contour.

In this application, optical gaging has effected a decrease from several hours of inspection time by a skilled workman to one minute by an unskilled operator.

Template Work Speeded

Both the making and checking of templates have been greatly speeded by another mirror arrangement using two external shadow illumination systems on a contour projector. One of these systems projects a horizontal beam and the other a vertical beam. The template stock to be ground or filed is placed in the horizontal beam.

A glass plate, on which has been scribed the contour of the template, is placed in the vertical beam. A semi-transparent mirror is located at the intersection of the two beams. The horizontal beam of light passes through the

Mr. Fultz is superintendent of tools and methods at the Hawk-Eye Optical Works, Eastman Kodak Company, Rochester, N. Y. This article is based on a recent address given by Mr. Fultz before a meeting of the A.O.A. Gage Industry Division in Philadelphia, Pa.

mirror, while the vertical beam is reflected by it into the lens system of the contour projector.

Thus, both the template stock and the scribed outline of the template, are imaged together on the screen.

It is advisable, in order to make both images clearly visible, to filter the beams in contrasting colors, as red and green (Fig. 3). With both images on the screen at once, the work of cutting away the template stock until the desired contour is achieved is greatly facilitated. Thus, a mirror again is stretching the available supply of manpower by making higher production per worker possible.

Inspecting Ports

Another ingenious mirror technique is involved in the inspection of ports in hollow cylinders or other enclosures. Obviously, neither shadow projection nor surface illumination of these ports is adequate for accurate inspection by optical gaging. But if a mirror is placed inside the cylinder it reflects the surface illumination beam back out through the port and outlines the contour of the port on the screen (Fig. 4).

This method has been used successfully to measure contours of valve ports, where odd-shaped openings made other gaging methods difficult and costly.

The contour projector has been placed not only in the inspection line but in the production line as well. As a result, rejections have been greatly reduced, and unskilled operators now perform the gaging operations fifty per cent faster than highly skilled operators formerly did it.

In still another application, mirrors are used to concentrate intense light on the object in the staging fixture of a contour projector. This has been done in inspecting vacuum tubes.

Before optical gaging was adopted these tubes were inspected with binocular microscopes, and, because of the tendency of the eye to refocus to the different depths of the tube, eye fatigue became a serious limitation to production rates. Frequent changes of operators were necessary.

1,000-watt Lamps

Now, however, with an arrangement of special lights, lenses, and mirrors on an optical comparator, the light from three 1,000-watt lamps is filtered to remove the heat and is directed to the

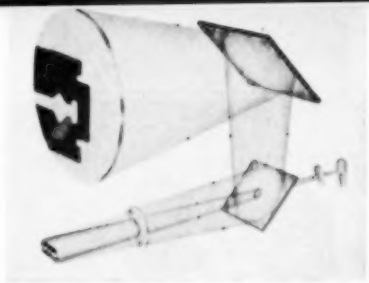


Fig. 1. Principle of mirror system now standard in optical comparators.

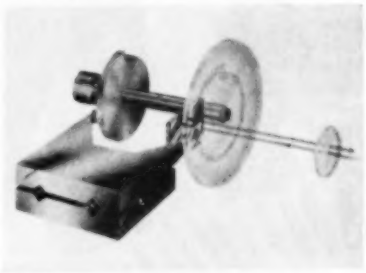


Fig. 2. Inspection of peripheral cam uses mirrors to project follower, tolerance limits, and nominal cam contour together.

Fig. 3. Templates are checked by mirror arrangements using two external shadow illumination systems projected on screen.

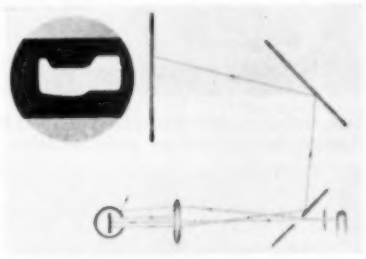
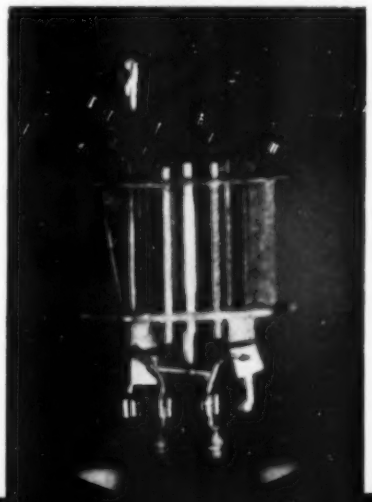


Fig. 4. Mirror technique used in inspection of ports in hollow cylinders. Fig. 5, below, magnified image of vacuum tube components projected on plane surface.



vacuum tube in the staging fixture (see top of page 180).

This intense light, reflected from the elements of the tube, forms a greatly magnified, full-color image of the tube components on the screen. Such critical factors as grid-wire spacing, grid-cathode clearance, and welds are easily visible. And, since these features are projected on the plane surface of a glass plate, refocusing of the eyes is eliminated (Fig. 5).

Fatigue Reduced

Fatigue is reduced to a minimum, and the operator can work through a full shift with only normal relief. This has resulted in increased production with fewer operators. Again, mirrors can be credited with stretching the supply of manpower.

The inspection of a series of eight metal plates which form a laminated mechanism has been greatly speeded up recently by optical gaging, with a 45-degree mirror playing a vital part.

Originally this mechanism was made of solid stock, ⅛-inch thick (Fig. 7). A pair of plates made a unit, and each of the plates was machined and drilled with a number of holes, some of them blind. Tolerances were as little as 0.0006-inch, and machining operations were slow and expensive.

Many Gages Needed

Fifty-eight mechanical gages (Fig. 6) were required to inspect these plates, and inspection was tedious and costly. Furthermore, for full-scale production three sets of gages were required, with one set being checked and another in stand-by storage, while one set was in actual use.

Demands for increased production necessitated redesign of the mechanism for laminar construction, so that punch presses could be used in the process. At the same time, optical gaging was adopted to speed up the gaging program.

Glass Plate Used

For the optical-gaging operation, some black squares were first photographed on a glass plate—one square for each hole to be checked. The glass plate was permanently mounted in a metal block, the sides of which were accurately ground to provide register with two locating pins in a bench loading fixture (Fig. 8). In operation the

Fig. 6, above, shows some of the mechanical gages used to inspect solid stock plates below (Fig. 7), which required separate drilling to close tolerances.

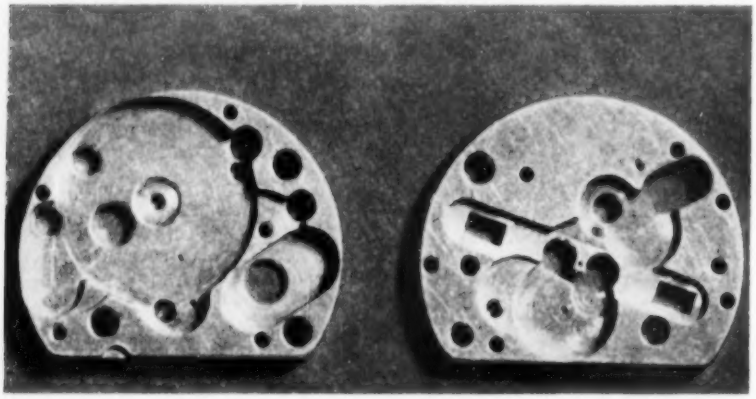
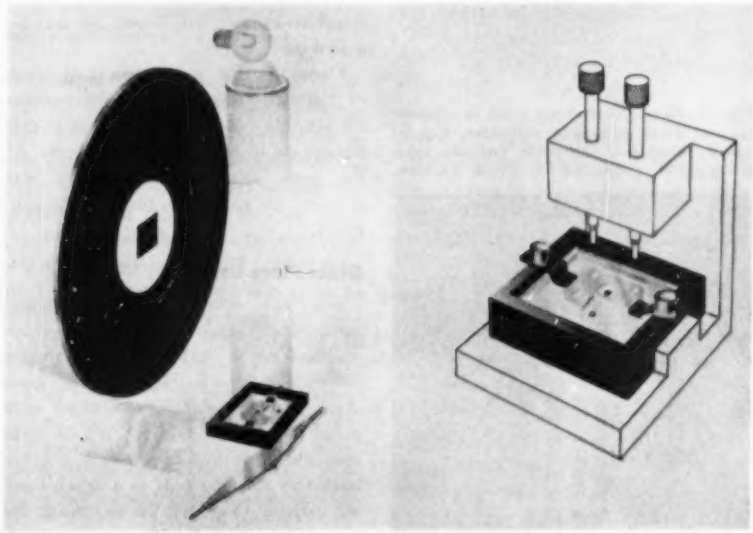


Fig. 8, below, shows optical gaging device which replaces mechanical gages above and permits laminar construction of the plates. Gaging can be done by unskilled labor.



block is placed in the bench loading fixture and the mechanism plate laid on top in direct contact with the glass plate.

Two locating pins then position the mechanism plate relative to the glass plate and the metal block, and the assembly is clamped in that position. Then the locating pins are removed, and the assembly is transferred to the staging fixture of a contour projector.

A vertical beam of light is passed down through the holes in the mechanism plate and through the glass plate as well and is reflected by a 45-degree mirror below the fixture into the lens system of the projector.

Hole Projected

On the screen, a bright disk of light is the projection of the hole in the mechanism plate and a dark square the projection of the square on the glass plate. The size of the hole is determined by comparing its image with a typical bridge chart, and the X and Y coordinates of the hole are determined by comparing the black square with a square outlined on the screen.

Thus, the large number of elaborate mechanical gages has been replaced with eight blocks and their associated glass plates, a bench loading fixture, a staging fixture on the contour projector, a chart screen, and a mirror.

Furthermore, gaging of the laminae by contour projection can be done by unskilled workers, with output considerably higher than when highly skilled gage operators were inspecting the machined units.

It is by techniques like these that gage engineers, supplementing their ingenuity with mirrors, are achieving significant savings in valuable technical manpower.

EDITOR'S NOTE.—Writing on gage procurement as a function of the Ordnance district offices in the November-December 1951 issue of ORDNANCE, Lieut. Col. Winthrop P. Hersey said:

"In dollar value the contracts placed and administered by an Ordnance district for the procurement of Government inspection gages are generally a very small percentage of the district business. In importance to the production of Ordnance matériel, however, the availability of well-designed, correctly made gages—on time—is a matter of first importance."

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JULY-AUGUST, 1953

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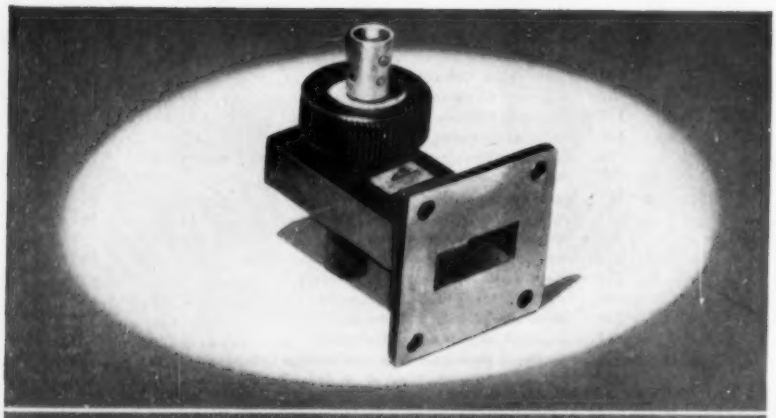
New X-Band Test Equipment

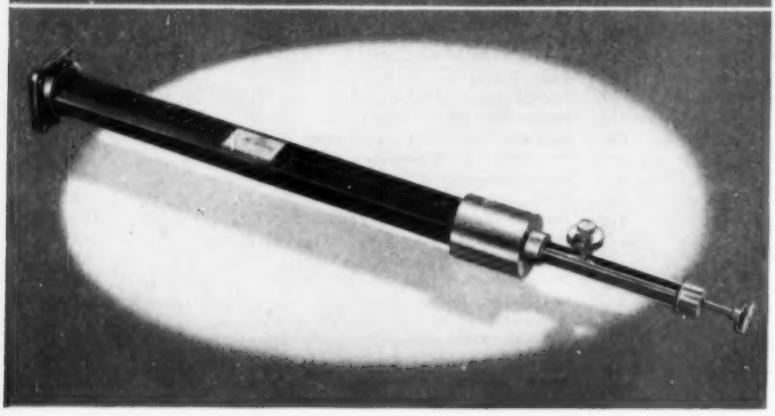
ADDITIONAL INSTRUMENTS ADDED TO MICROLINE*



Model 219C Waveguide Thermistor Mount

This instrument is used in conjunction with accessory equipment to measure and monitor microwave power at average power levels as low as 10 microwatts. It is particularly useful in the measurement of pulsed power. This thermistor mount is recommended for use with the Microline Model 123B Wattmeter Bridge.

Frequency Range	8.5 – 9.6 kmc.
Maximum VSWR	1.5
Operating Resistance	135 ohms
Maximum Power Rating	10 mw.
Waveguide Size	RG-52/U (1" x ½")



Model 495 Adjustable Termination

This instrument is specially adapted for use in precise microwave measurements where the quality of excellent impedance matching over a broad band is essential. The design of Model 495 provides for independent control of phase and amplitude of the reflection coefficient of the load. It is particularly useful in applications requiring a termination of minimum power reflection, a movable termination where the reflection from the termination can cause error in measurements, or as a means of matching low standing wave ratios to obtain the smallest possible reflections.

Frequency Range	8.1 – 12.4 kmc.
VSWR Range	1.005 – 1.15
Phase Variation	360°
Waveguide Size	RG-52/U (1" x ½")
Power Rating	5w.

Our nearest district office will be glad to supply complete information upon request.

OTHER X-BAND MICROLINE INSTRUMENTS

MODEL	INSTRUMENT
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New Bullard vertical chucking grinder gets high precision, handles heavy loads with table on TIMKEN® bearings

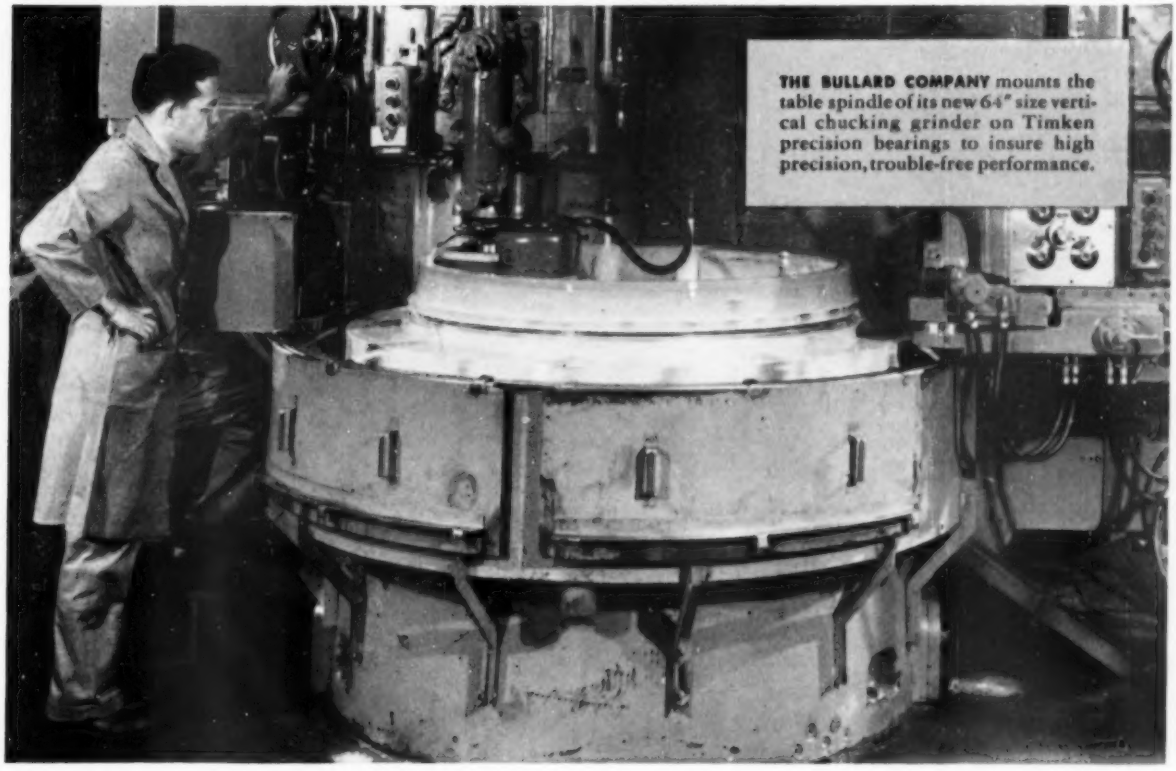
TO insure the high precision needed in finishing cups and cones for large-size roll neck bearings, Bullard mounted the table spindle of a new 64" size vertical chucking grinder on Timken® tapered roller precision bearings. Timken bearings are also used in many other vital spots.

Line contact between their rollers and races gives Timken bearings extra load-carrying capacity. Their tapered construction takes radial and thrust loads in *any* combination. Result: Shafts are held in rigid alignment. Shaft deflection and end-play are minimized. Gears mesh smoothly. Spindle precision is assured.

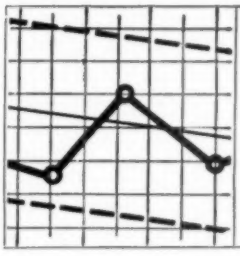
True rolling motion and an incredibly smooth surface finish make Timken bearings practically friction-free. Maintenance and lubrication time and costs are cut to a minimum.

Precision manufactured, made of Timken fine alloy steel and engineered for the job, Timken bearings normally last the life of the machine. Specify Timken bearings in the machinery you build or buy. Look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



THE BULLARD COMPANY mounts the table spindle of its new 64" size vertical chucking grinder on Timken precision bearings to insure high precision, trouble-free performance.



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In close collaboration with the Armed Forces since 1918, and more recently with the Atomic Energy Commission, Arma has contributed much in basic research, design, development and manufacture to the advancement of electronic and electromechanical weapon control, navigation, and other precision remote control systems. There is every reason to believe that engineering background and techniques—first used successfully in these devices—will see widespread industrial applications. *Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y. Subsidiary of American Bosch Corporation.*

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